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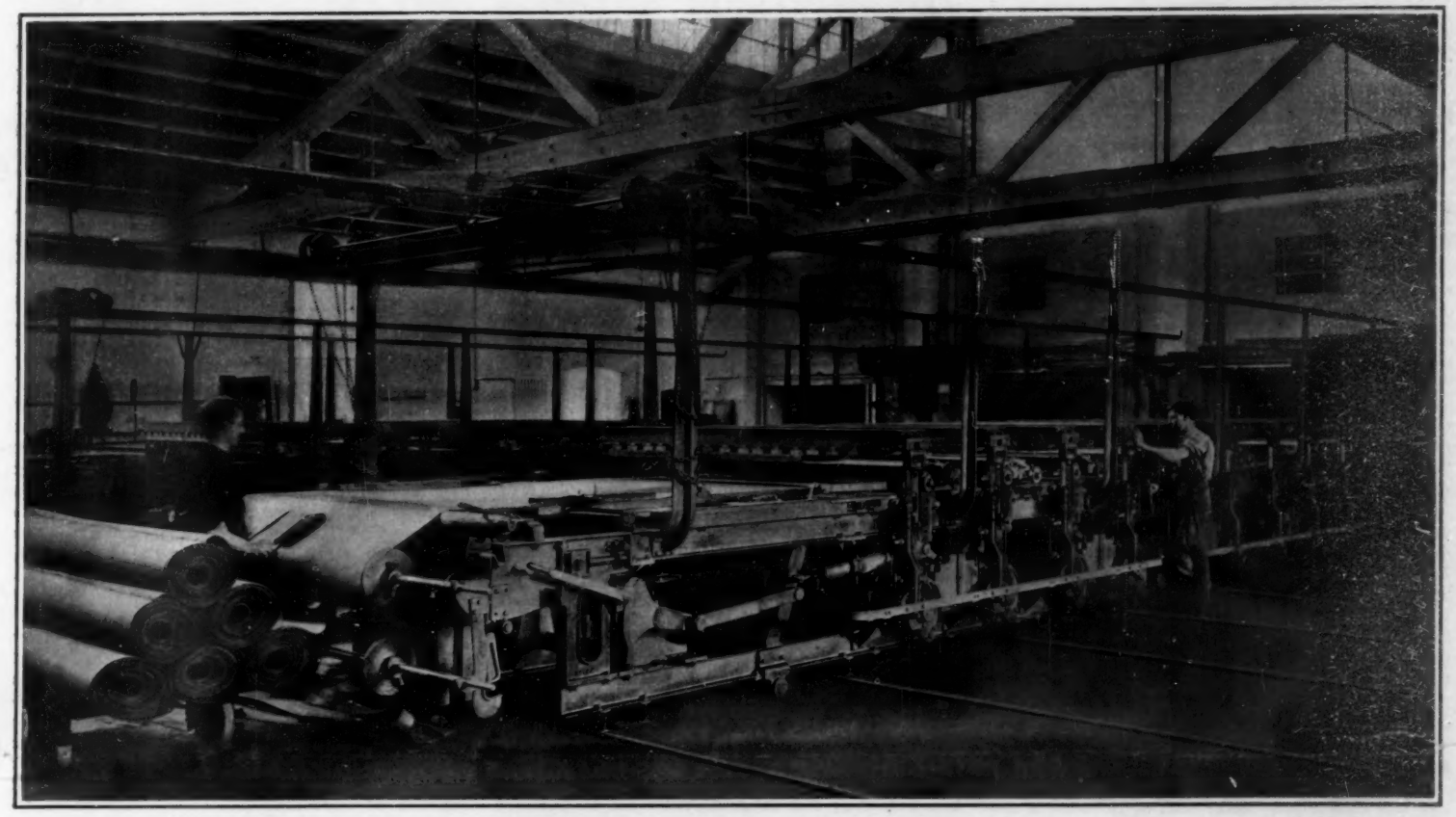

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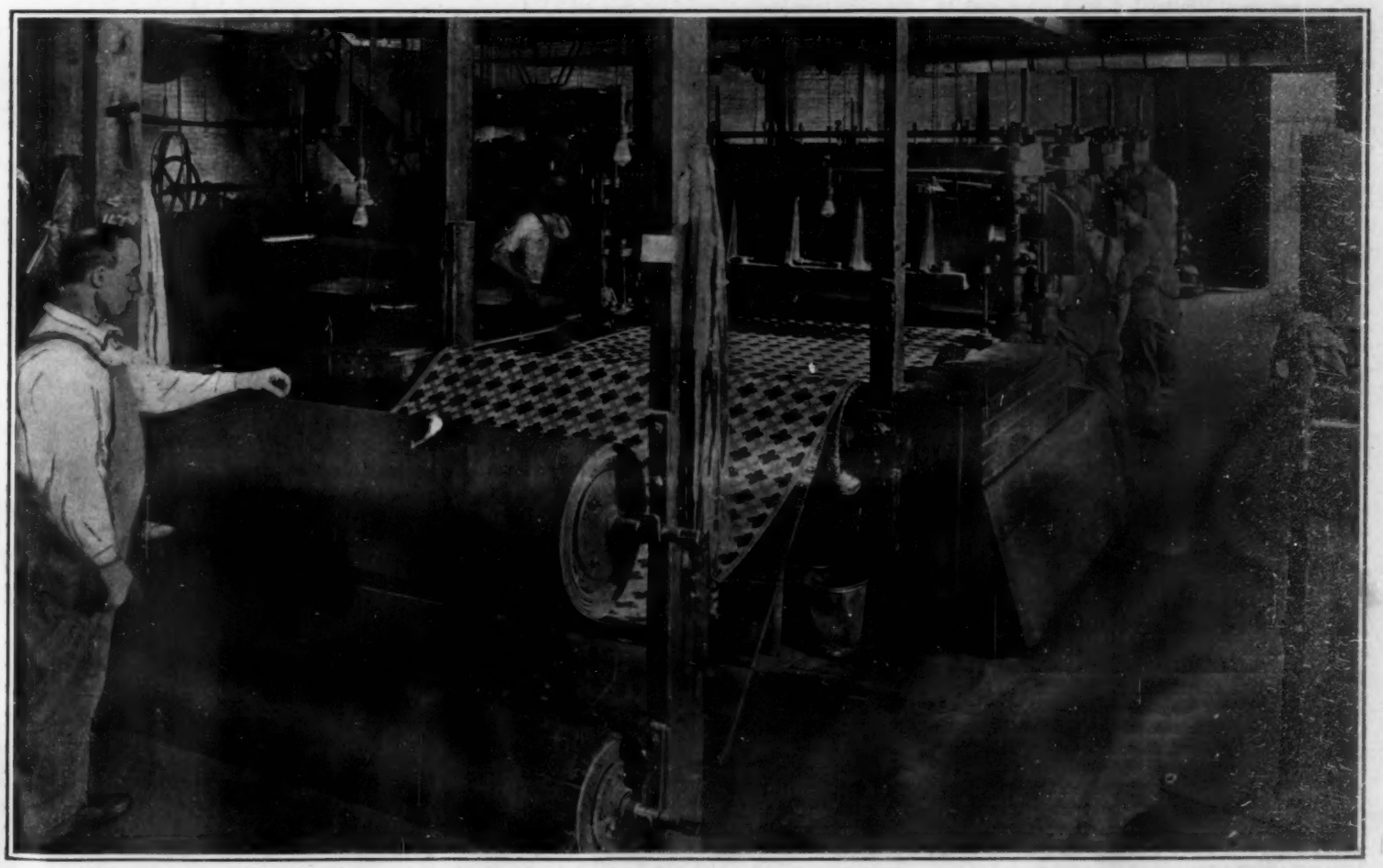

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HOW LINOLEUMS AND OILCLOTHS ARE MADE.—[See page 28.]

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NEW YORK, SATURDAY, JULY 13, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

NAVY TO BUILD "OCTOPUS" TYPE OF SUBMARINE.

The submarine torpedo-boat board, which recently conducted a series of tests of submarine boats, has decided unanimously in favor of the superiority of the "Octopus" type. This view is indorsed by the Board on Construction, and is approved by Secretary Metcalf of the Navy. In agreement with the report, the award of $3,000,000 authorized by Congress at its recent session for the purchase of submarine boats, will be made to the Electric Boat Company of this city. The competition upon which Congress decided, when it made an appropriation two years ago of $1,000,000 for submarine boats, was recently concluded off Newport. This original appropriation was increased, at the recommendation of the President to the last Congress, to $3,000,000, and the time fixed for holding the test was limited to the 29th of May of this year. Although the details of the report have not been given out, it is known that the "Octopus" was considered to have outclassed her competitors on all essential points. She was considerably faster both at the surface and in the submerged condition; showed better ability to maintain a constant level of submergence; and developed at least equal structural strength when sunk in great depths of water.

ELECTRIC POWER PLANTS ARE RESPONSIBLE.

After a contest in the courts which has lasted for seven years, it has been decided by the Appellate Division that the responsibility for fires resulting from defective wiring and insulation rests upon the electric power companies. The legal contest which has just been ended was begun in February, 1900, when an insurance company brought suit against the New York Edison Company as being responsible for the burning of a block of buildings at Third Avenue and 190th Street in this city, the claim being made that the fire was caused by improper insulation. In this particular case, nine insurance companies paid a loss of $100,000 on the fire; and, subsequently, sued the Edison Company. The first action was brought by the German-American Insurance Company, which won in the Appellate Division, and later in the Court of Appeals. The Edison Company was not satisfied to let the matter rest, and brought suit against the insurance companies, which, however, obtained a favorable decision. The testimony given at the trials proved that the wires had been put up on the building which was burned down, without the consent of the owner and in a negligent and reckless manner. It is estimated that there are in the United States damages every year amounting to about $25,000,000, due to defective electrical construction and insulation. Henceforth the responsibility for this will be laid upon the electric companies, instead of falling as hitherto on the insurance companies.

THE STEEL RAIL PROBLEM.

The agitation over the steel-rail scandal promises to bear fruit. A conference was recently held at the offices of the Steel Trust, at which were present representatives of the steel companies and of every important railroad in the country; and at the close of the conference the chairman of the trust, who presided at the meeting, announced that an agreement would be reached which would be satisfactory to the public. Although no official report of the conference has been issued, it is understood that the steel companies expressed their willingness to make a rail that would come up to the requirements of the railroads, provided that the railroads would pay five dollars a ton more for the rails; or thirty-three dollars in place of the present price of twenty-eight dollars per ton. It was generally recognized that a change is necessary in the shape of the rail, and it is probable that the standard type adopted will contain considerably more metal in the base, with a view to securing a more even distribution of temperature in the various portions of the rail during the process of rolling, and also of providing a rail that will be better able to withstand the reverse bending stresses which occur at all times and, particularly, during the frosts of the winter months. Now that the manufacturers and the railroads have got together, and strong committees representative of each are engaged in a joint and friendly investigation of the subject, the public has some assurance that the future output of the rail mills will be more reliable, even if more costly, than that which has characterized the past few years. The question of price is one that does not concern the general public, which merely demands that railroad travel shall be made safe again; but we understand that the leading railroads have expressed their willingness to pay a higher price if they can only secure a thoroughly reliable rail.

CONTRACT AWARDED FOR TWO "DREADNOUGHTS."

The awarding of the contracts for the two 20,000-ton battleships marks the beginning of a new era in the history of naval construction in the United States. It is true that the "South Carolina" and "Michigan," now under construction, embody the characteristic feature of the new type to the extent that they are armed exclusively with the 12-inch gun, of which each vessel carries eight. But the appropriation for these two ships, and their size, was determined by Congress before the one-caliber-all-big-gun battleship had been accepted as the type of the future; and hence, they are not strictly representative of the class. The new ships, however, are purely of the "Dreadnought" type, all the elements of their design being subordinated to their definite duty of carrying into battle the largest possible number of 12-inch guns. Of these each ship will carry ten, disposed in five separate turrets. It has ever been the aim of the naval constructor so to mount the guns that each one of them shall be able to cover the widest possible arc of the horizon, and do so without interfering with the training of the other guns, that is, without masking them or being itself masked. It was the determination of our constructors to abide strictly by this principle, that has enabled them to secure a concentration of fire from their ten guns which is twenty-five per cent greater on the broadside than that obtainable with the ten guns of the British "Dreadnought." This desirable result has been secured by mounting all of the five turrets upon the longitudinal center line of the ship, with the result that every gun can be trained through a wide arc on either broadside; whereas only eight guns can be so trained on the ten-gun British ship. It is true that the "Dreadnought" has a heavier end-on fire, due to the fact that two of the turrets are carried in the wings, or on the beam of the ship, an arrangement which enables her to deliver a fire of six 12-inch guns ahead, or astern, as against four such guns in our new 20,000-ton ships. But since these wing turrets mask each other in broadside fire, it follows that the heavier fire end-on has been secured in the "Dreadnought" at the sacrifice of broadside fire—and it is well understood in naval tactics that future battles will be fought by preference in the broadside rather than the end-on position. It will be evident, then, that the advantage of a twenty-five per cent more powerful broadside fire has been obtained without any extra cost of weights for gun emplacements, except so far as the extra length of ship necessary for this arrangement must be debited to that account.

The "Dreadnought" is of 18,000 tons displacement, therefore our 20,000-ton ships have some 2,000 tons advantage in displacement, much of which our naval constructors have been enabled to devote to protective and defensive qualities. Just what use has been made of this displacement has not been announced by the Navy Department, for it was not desirable that such important information should be made public. We are in a position to state, however, that our new vessels, being larger and being designed with all the valuable facts which have been developed during the trials of the "Dreadnought" available, are structurally stronger and stiffer, and are superior both in the thickness and area of their armor, and in the provision of bulkheads, double floors, and other structural devices designed to localize torpedo injury and preserve the buoyancy of the ship.

The experience of the Russo-Japanese war, particularly at the battle of the Sea of Japan, proved that it is better to provide a limited number of guns upon a hull that can be absolutely depended upon to keep those guns afloat, than to load double the number of guns upon a hull which can be riddled with high-explosive shells and sent to the bottom before the engagement can be said to have fairly begun. Other things being equal, it is the ship which can longest preserve its buoyancy that will win the fight, and it is satisfactory to know that in our two new 20,000-ton battleships we shall have two vessels which will probably stand more hammering, with one exception, than any battleships designed at the same time as themselves.

Big as these ships are, however, they will be surpassed by the new Russian battleships, which are to displace 21,800 tons. It is authoritatively stated that the whole of this extra displacement (for they will carry only the same number of 12-inch guns as our own ships) is to be devoted to the protection of the buoyancy. Among other means adopted to this end is the complete armoring of the ships, from a level considerably farther below the waterline than has been the practice in the past, up to the level of the upper deck; that is to say, the whole of the hull is to be armor-clad. In this connection it is interesting to remember that the idea is not original with the Russians; for as far back as the year 1890 the French built a cruiser, the "Dupuy de Lome," whose whole hull from 4½ feet below the waterline to the upper deck is completely clad with armor. Evidently, when the Russian government turns over these monster ships to their commanders, she wishes to be in a position to say to them, "You have now beneath your feet a ship which cannot be sunk; fight her, therefore, as long as there is a gun that can be trained upon the enemy."

Of our two new battleships, one has been let to the Newport News Company for the remarkably low price of $3,987,000, if she is built under the Department's plans, or for $4,090,000, if built under the company's plans as modified by the Department. The other ship has been let to the Fore River Company, for a contract price of $4,377,000. The former ship is to be built in thirty-six months; the latter, in thirty-four and one-half months. The ships will be identical, except for the fact that the Fore River Company will use the Curtis turbines, and the Newport News Company, turbines of the Parsons type. One of the ships is to be named the "Delaware," and the other will carry either the name "New York" or "Empire State."

BOARD OF UNDERWRITERS ON CEMENT CONSTRUCTION.

With a view to determining the fire-resisting qualities of cement and concrete, and formulating a standard specification for their use, a special committee of the Board of Underwriters has been engaged in an exhaustive study of the subject. Because of the San Francisco conflagration, the past year, in particular, has been fruitful in knowledge of the fire-resisting qualities of these materials. The chairman of the committee refers, in his report, to one difficulty of the investigation arising from the fact that the action of concrete, when combined with reinforcing materials, has been hitherto only partly understood, and experimental data on the subject is, even at this day, comparatively scarce. The Board, however, has issued a revised edition of a model building code, which it is urging the municipalities throughout the country to adopt. One section of the code refers exclusively to reinforced concrete construction, and the committee strongly urges that the design of concrete buildings should be undertaken only by engineers of special training and experience in this line of work. In our opinion this is the most important recommendation made in the whole of this section of the report. We have always believed that the peril of concrete construction lay in the supposed ease with which it could be built, and in the common belief that the design of reinforced concrete structures was a very simple matter, and the building of the structure even simpler still. No greater mistake could possibly be made. The design of a reinforced column or beam calls for as much and even more technical knowledge and skill than the design of an ordinary steel column, plate girder, or truss, in steel bridge work. In bridge designing the well-established data and formulæ necessary to the working out of the problem are available; but in designing reinforced concrete work, there are no such complete data at hand. The art is a new one; and the exact behavior of reinforced concrete under certain conditions is, even to-day, largely a matter of theory. Hence, the question of the amount and proper position of the steel reinforcement is one that calls for the exercise of a judgment which has been ripened by experience. It is essentially a civil engineer's problem, and every architect who undertakes the design of concrete steel work should be master of the main principles of the civil engineer's profession.

Furthermore, it is a mistake to suppose that concrete-and-steel construction, because of its apparent simplicity, can be done by ignorant labor under the supervision of an unintelligent foreman. The report says that the experiences of the last year have given additional proof of the gross carelessness and incompetence which have prevailed in many important works. There have been several instances of the collapse, during construction, of large and expensive buildings, which have been traced in every case to the neglect of well-known rules of safety. In one case,

where there was lack of intelligent superintendence, the cheap labor did not appreciate the need for careful workmanship, and the result was the use of too little cement, or too little water, or improper mixing, followed by the collapse of the wall before it had reached half its full height. In several cases the concrete, while under construction, was allowed to freeze, and as soon as the forms were removed its inevitable collapse followed. In other cases the wooden molds or forms had not been properly cleaned out, and shavings, blocks of wood, and other refuse had been so imbedded in the concrete as to introduce a fatal weakness at important points in the building. In another case reinforcing rods were put in the wrong place, or omitted altogether, and these faults coupled with unsafe design, caused one of the most serious of the recorded wrecks of concrete buildings.

The popularity of hollow-concrete block construction has increased rapidly during the past year, and the report specifies six conditions which, if followed, will give the highest fire-resistance qualities in a hollow-concrete block building. First, the thicker the shell of the block, the better the resistance; secondly, the block should consist of a brand of Portland cement that conforms to the standards of the American Society of Civil Engineers, or some similar specification of high authority; thirdly, the block should contain not more than four parts of sand or other material to every one part of cement; fourthly, the best block is that which is made with the wettest mixture practicable; fifthly, the block should be carefully cured for not less than thirty days before it is used, and, during this time, it should be frequently moistened by water spray or steam; lastly, in hollow-block buildings, care should be taken to use solid blocks for the course on which joists or girders rest; that is to say, care should be taken never to allow the concentrated load of such members to rest upon or depend from the inner side of a hollow shell, since this may very readily break off.

THE GRAND PRIX INTERNATIONAL AUTOMOBILE RACE.

The third great international automobile race of the year was run on a triangular circuit near Dieppe, France, on the 2d instant, the result being the fastest time that has ever been made in any long-distance race of this character—70.77 miles an hour. The winning car was an Italian Fiat racer driven by Nazzaro. Szisz on a Renault was second, with an average speed of 69.46 miles an hour. Thus the positions of these two champions were just the reverse of their positions in the Grand Prix of last year, when Szisz won on his Renault at an average speed of 62.84 m.p.h., and Nazzaro was second on his Fiat at a speed of 60.2 m.p.h. The race last year was much longer, however, and it was run on two consecutive days. The total distance was 745 miles, while the course was 62 miles in length. The fastest circuits were made at 73 and 72 miles an hour. The Dieppe course was shorter and not particularly difficult. It extended southwest to Londinières, then north to Eu, and finally southwest to Dieppe. Its actual total length was 76.988 kilometers, or practically 77 kilometers (47.84 miles) in round numbers. Ten circuits of the course were required to be made.

No less than 37 machines, consisting of 2 English, 24 French, 3 German, 3 Italian, 3 Belgian, 1 Swiss, and 1 American make, started, and 16 of these completed the race. Of the one Italian, German, Belgian and seven French firms which entered three cars each, but one succeeded in bringing all three across the line at the finish. Three Brazier cars finished third, seventh, and twelfth, with their usual regularity. Accidents and breakdowns put most of the others out of the running, while tire trouble does not seem to have bothered the contestants greatly, presumably on account of the elaborate arrangements for tire renewal and the use of detachable rims. It was largely on account of these conveniences, no doubt, that the average speed has been raised nearly ten miles an hour in a single year.

The second annual Grand Prix race was run on the basis of fuel consumption, and it was lack of fuel which caused Lancia, who also drove a Fiat, to lose third place. His fuel gave out on the last lap, leaving him stranded by the roadside. The cars were allowed 61 gallons each, which required them to run 7.84 miles on a gallon. That one car should win the race at a speed of 70¾ miles an hour and still have nearly three gallons remaining, while another of the same make was unable to finish on account of lack of fuel, seems rather remarkable, and hardly explicable on the ground of difference in the driving of the two cars. Possibly Lancia, with his usual bad luck, lost some of his fuel. At any rate, he could not blame Walter Christie in this race for putting him *hors de combat*, as was done in the Vanderbilt Cup race of 1904, in which Christie just grazed the Italian as he was pulling out into the road after making tire repairs, and, by smashing his rear wheel, snatched the victory from him. Nor could Christie blame Lancia for his usual bad luck, as a result of which our patriotic countryman, who drove the only Yankee speed creation that participated, succeeded in completing only four rounds at an average speed (including time lost for stops) of about 40 miles an hour. His engine is said to have broken a valve, and, according to cable reports, he also had trouble with one of his clutches sticking.

The race this year was noteworthy from the fact that, with only a single exception, all the machines that were entered started, and that most of them started at the time set. Heath with his Panhard was the only exception. On account of difficulty in starting his engine promptly, he was delayed for a minute or more at the start. Most of the contestants carried about a quart of gasoline in a separate can, for the purpose of priming the carbureter when starting at various places along the course.

Three minutes after the last machine had started, Lancia rushed past the grand stand at terrific speed, followed closely by Duray in his De Dietrich. Wagner, on his Fiat, made the first round in 39 minutes and 53 seconds, which was at the rate of 71.97 miles an hour. At the end of the third round he was leading and his chances were good, but on the fourth round something went wrong with the motor, and he was out of the race. For the remainder of the race Duray led, and was continually gaining on every competitor until just after he finished the eighth round, when a bearing broke and his car came to a stop. Lancia, Szisz, and Nazzaro were the other leaders. The Frenchmen hoped that Szisz would be able to increase his speed sufficiently to pass Nazzaro; but he failed to do this, and finally finished second in 6 hours, 53 minutes, and 10 seconds, as against Nazzaro's time of 6 hours, 46 minutes, and 33 seconds. Baras, on his Brazier, was third in 7 hours, 5 minutes, and 5 3-5 seconds (67.52 m.p.h.) and Gabriel on his De Dietrich, fourth, in 7:11:37 (66.5 m.p.h.). Two Darracq machines finished 59 seconds and 261 seconds after Gabriel. As stated above, a second Brazier car was seventh, and this was followed by two Bayard-Clement cars, the times of which were 7:34:16 and 7:39:56, respectively. Hemery, on a Mercedes, was tenth in 8:25:25; a Motobloc finished eleventh; the third Brazier, twelfth; a Renault, thirteenth; two Germains, fourteenth and fifteenth; and a second Motobloc sixteenth. The time of the last car was 10:24:57, which corresponds to an average speed of almost 46 miles an hour.

The fastest lap of the race was made by Duray on his De Dietrich car in 37 minutes and 54 seconds, which corresponds to an average speed of 75.73 miles an hour. The race is considerably the fastest that has ever been run, being nearly 5 miles an hour faster in its general average than the Ardennes race of last year. It was noticeable for the numerous breakdowns and for the failure of many of the French and German makers to make a good showing. It is the third great race that Nazzaro has won this year, the other two being the Targa Florio Stock-Car Race in Italy, and the German Emperor's Cup Race in Germany, last month. The Italians have certainly made great strides in automobile manufacture, and in the development of a reliable and speedy car they are apparently second to none.

GASOLINE MOTOR CARS ADOPTED FOR BRANCH LINE SERVICE ON THE UNION PACIFIC RAILROAD.

An extremely interesting innovation in railway passenger transportation in this country will be inaugurated this month, during which, it is announced, the Union Pacific Railroad will place in service twelve gasoline railway motor cars. The cars are intended for branch-line traffic, where the fast and frequent service required cannot be maintained by ordinary trains except at a loss.

The latest type of these cars developed at the Omaha shops of the Union Pacific makes 60 miles an hour with a 200-horse-power engine, reaches high speed within six car lengths, and can be stopped within 120 feet. With these advantages the cars can be put on a much faster schedule than is possible with the steam locomotive.

Outwardly the newest of the cars, which are built entirely of steel, resemble a turned-over racing yacht. The forward end tapers sharply, and the roof and rear are rounded off to reduce the air resistance and avoid the vacuum produced by a square car. Rounded windows give to the passengers a wide range of outlook, and increase the nautical appearance of the car.

In cold weather the cars are to be heated by hot water from the cylinder jackets. They are lighted by acetylene gas shining through opalescent panels.

For sanitary reasons the floors of the cars are built so that they can be thoroughly cleaned by flushing with hot water. The familiar system of ventilation has been replaced by roof ventilators, which exhaust the inside air by suction, fresh air being taken in from the car roof in front. Vibration is reduced to a minimum by the way in which the motive power is balanced.

The cost of operating the cars varies from ten to twenty cents a mile, according to the density of the traffic, but the records kept prove beyond doubt that the railway motor car will make possible great improvements in handling branch-line passenger traffic.

SCIENCE NOTES.

An additional research is now being prosecuted at the Harvard College Observatory, with the object of determining the distribution of variable stars in various regions of the sky. The method is a photographic one, and consists of superposing negatives of a certain region on a contact print taken from a second negative of the same region, obtained at a different time. In the instances described, five negatives of each region were employed, four of which were compared with prints from the remaining one. The stars showing signs of change are marked, and on subsequent reduction, some of these may prove to be known variables, some to be new variables, some are still suspected of variability, and some may be due to photographic defects. From the number of actual new variables found by superposing plates of the same region, an estimate may then be made of the number still undiscovered. In the trials so far made the results appear so promising that it seems best to cover the whole sky by the method as soon as possible, and thus provide for determining the probable distribution, and later the work can be confirmed and extended by means of photographs with a larger instrument. As the result of this preliminary count, it appears that the greater proportion of existing variables have been detected, and of those still undiscovered it is probable that all are faint, none being estimated as brighter than the eighth magnitude, or having a range of variation of more than a magnitude.

The odor of plants is due to active constituents in the volatile essential oils, the proportion of which varies at different periods of the growth. In order to study the formation and distribution of the essential oil MM. Charabot and Laloue have made a series of determinations of the amounts present in different stages in different parts of the plant, taking absinthe (*Artemisia absynthium*) as typical of an odor-forming plant. They find that in the first stage, a long time before blossoming, the roots are free from essential oil, while the leaves contain about eleven times as much as the stalks. In the second stage, the beginning of blossoming, the roots become richer than the leaves in the oil, though all the organs show a considerable increase, the proportion in the leaves, for instance, being about doubled. In the third stage, advanced blossoming, the accumulation of oil in the roots is more pronounced, but there is a diminution in the stalks, leaves, and particularly in the blossoms, showing that there is a consumption of odoriferous constituents in the process of fertilization. In a typical experiment the relative amounts yielded by the plant on July 10 and August 4 were 1,055 and 766 milligrammes. Hence it is evident that for the practical purpose of extracting the scent from flowers it is advisable to prevent fertilization, or, better still, to extract the essential oil at an earlier period. In the fourth stage, when blossoming is over, the relative proportion of oil in the roots is greater, and there is also a slight increase in the proportion in the stalks. The small absolute increase in the amount of oil then yielded by the whole plant is to be attributed to the appearance of new leaves.

Among the most recent finds which have been made at Carthage by Rev. P. Delattre are a number of sarcophagi which present a great interest. In many of these the top cover is sculptured in relief with a figure of life size, carved out of marble, and beautifully tinted in various colors. One very fine specimen was found in the necropolis at a depth of twenty-five feet. On the cover is a figure of a woman executed in the Greek style, with a long garment reaching to the ankles and a veil covering the head. Great technical skill is shown in treating the different tissues. The flesh parts are well polished, and the eyes are painted, giving a life-like aspect. The hair is gilded. Inside the sarcophagus were found the remains of the person, with some bronze objects. A second sarcophagus was that of a person supposed to be a priest. The sculptured figure has abundant hair and a curling beard. It wears a long robe with short sleeve. Here also the eyes are painted, and are very expressive. Among the remains are a massive gold ring with a portrait similar to the above, also three other gold rings, amulets, etc. One of the most recent finds was a sarcophagus with the sculptured figure of a woman wearing a long tunic of fine wool of a pinkish hue, with a gilded belt passing under the breast. The lower part of the body is enveloped in what appears to be two great vultures' wings, according to the Egyptian style. The whole figure bears traces of painting and gilding. As to the remains, they are imbedded in a resinous matter, as is often seen. M. Delattre examined the specimens carefully to observe the painting before they came up to daylight, as the colors faded almost at once, and he found the color and gilding to be quite brilliant both on the figures and on the moldings of the sarcophagi. These specimens form an important addition to the Carthage Museum.

A TRACTION WHEEL WITH SINUSOIDAL TREAD.

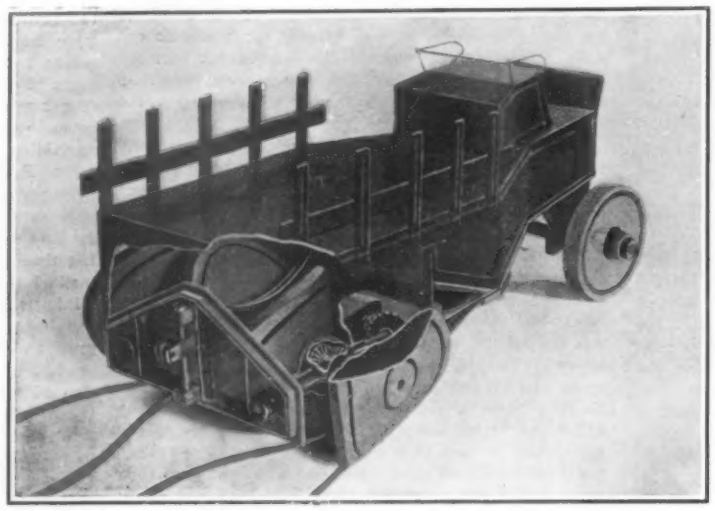
A traction wheel has recently been devised which is provided with a perfectly smooth steel tread. The usual cleats or ribs are done away with, and yet the tractive efficiency of the wheel is superior to that of the ordinary construction. This is due to the fact that the tread is laterally curved. It is rather difficult to explain the peculiar formation of this wheel without exhibiting a model of it; but we must content ourselves with a photograph of the model, which is reproduced herewith. Each wheel is virtually a double wheel, consisting of two members bolted on a single hub. It will be observed that each tread is comparatively narrow, and that at all points it is parallel with the axis. The periphery of the wheel forms a perfect circle, as viewed in the direction of its axis; but when viewed in the plane of rotation, it will be seen that without departing from the true circle, the treads of the two wheel sections are oppositely curved, so that when drawn along the ground, the double wheel will trace a double sinusoidal track with the curves of the respective tracks oppositely disposed. Were it not for this opposed disposition, there would be a tendency for the vehicle supported by a set of these wheels to move from side to side of the road, in the event that all the wheels chanced to contact with the ground at the same part of their respective peripheries.

The construction of the wheels is quite simple. Each section of the double wheel is composed of two elliptical plates of steel bent or curved on their minor axes. These plates are fitted together, and secured to the hub with the minor axis of one lying at right angles to the minor axis of the other. The edges of the two plates are bent toward each other, parallel with the hub, and the edge of one plate telescopes with that of the other, thus forming the tread of the wheel. This construction makes a remarkably strong yet simple wheel, which is much lighter than the ordinary broad, cleated traction wheel. There is no tendency to distortion, and no lateral strain on the axis, as the point of suspension is always in a straight line.

The inventor of this wheel, Mr. Bernhard Beskow, of this city, claims a large number of advantages for this wheel. As the tread is perfectly smooth, there can be no objection to its use on any highway or street. In fact, the wheels will roll the road rather than cut it. There is no danger of forming ruts, because the track zigzags back and forth across the usual wheel tracks, and it is doubtful if any two vehicles fitted with sinusoidal wheels would ever chance to follow in identically the same tracks. The wheel should, therefore, be an excellent one, not only for traction engines, but for auto trucks as well. One of our engravings illustrates a truck fitted with these wheels, showing the peculiar serpentine form of track they trace. The wheels may be chain-driven from a universally jointed countershaft, or, as shown in the illustration, they may be driven by bevel gears, so that they can swing at right angles to their plane of rotation to adjust themselves to the inequalities of the road.

It may seem odd that a smooth-tired wheel, even of this shape, could obtain a powerful grip on smooth or slippery pavement, such as asphalt. Perhaps the action of the wheels may be more clearly understood if we call to mind that method of skating on ice, which is done without lifting the skates from the ice by merely toeing in and out. The sinusoidal tread behaves in exactly the same way. Its tractive power is explainable on the principle of the inclined plane, as a moment's thought will show.

One of the disadvantages of the ordinary cleated wheel is that the cleats are liable to lose their efficiency by becoming clogged with mud and dirt. But such conditions could not possibly occur with sinusoidal wheels. The inventor has demonstrated with a full-sized machine, equipped with these wheels, that it will operate powerfully in deep mud and even in deep, loose sand. The deeper the wheels sink into the sand or mud, the greater the bearing surface they offer; and even if they should sink in to the hubs, they would still exert a powerful tractive effort, owing to the peculiar curved sides of each wheel. There is no tendency for the wheels to sink themselves into loose or yielding soil when an obstruction to their advance is met. In case an obstacle is encountered by one of the wheels, such as a projecting stone which is too large to be overridden, the wheel will turn without advancing until the lateral motion of the point of contact of the tread carries it to one side, and permits it to clear the obstacle. All of these advantages render the wheel particularly valuable for agricultural purposes, or for military use on yielding soil.



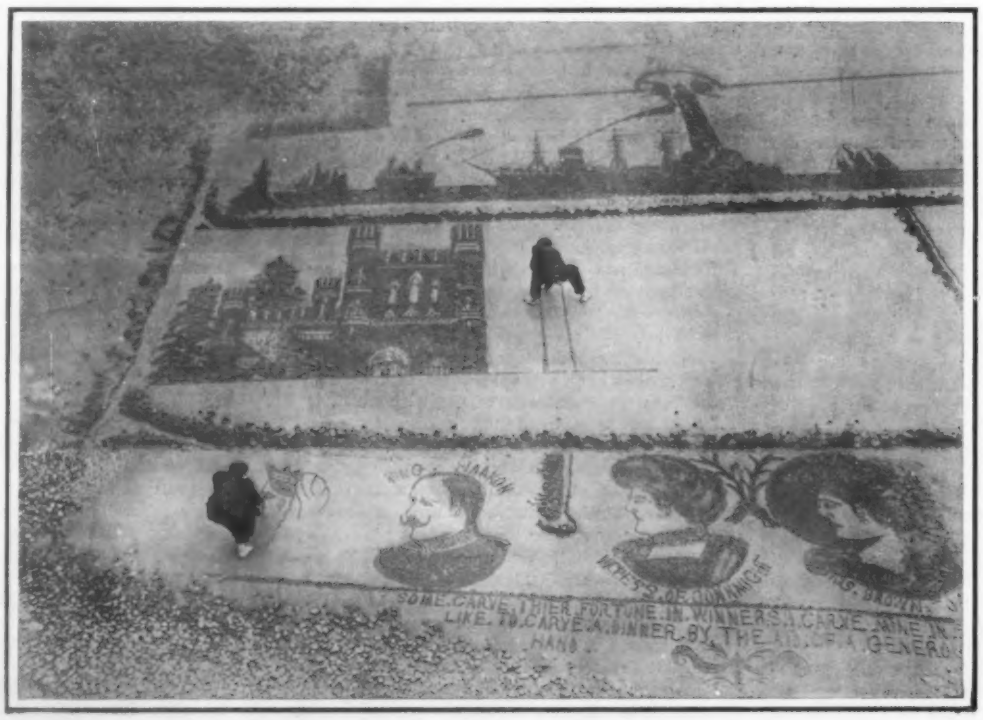
AUTO TRUCK MOUNTED ON SINUSOIDAL TRACTION WHEELS.

MODEL OF THE WHEEL WITH SINUSOIDAL TREADS.
Each wheel is virtually a double wheel, consisting of two members bolted on a single hub.

The Hissing Point of the Metallic Arc.

There was presented at a recent meeting of the American Physical Society, and reprinted in the April issue of the Physical Review, a preliminary report dealing chiefly with the arc between iron and copper terminals. The report is the work of Mr. H. D. Arnold and Mr. W. G. Cady. It is stated that the so-called iron arc is, in air, an arc between molten globules of magnetic oxide of iron. By letting the arc burn until it has become normal, observations can be made that compare in accuracy with those in the case of the carbon arc. The difficulty encountered in obtaining reliable observations in the neighborhood of one ampere led Mr. Arnold to the detection of an abrupt change in the iron arc analogous to the hissing point of the carbon arc. For currents below one ampere the arc burns quietly, and there is no well-defined spot of light on the globule at the anode. As the external resistance is decreased so that the current increases beyond a value depending largely on the curvature of the globule, the arc suddenly contracts, a bright spot appears on the anode, hissing commences, potential difference drops, and current increases slightly. Experiment showed that the effect is confined mainly to the anode. When the current is decreased, the change back to the quiet stage does not take place until the current has become smaller than it was when hissing commenced, due, doubtless, to the high temperature at the anode. The spectrum of the iron arc shows no further change, at the hissing point, than a general brightening of lines. When the current is increased to about two amperes, the iron arc emits a whistling sound, and the spot at the anode has a tendency to travel around rapidly, describing a circular ring. With copper electrodes, 6 millimeters thick, the hissing point occurs when the current is about 0.5 ampere, with about 110 volts across the arc.

The arc between aluminium electrodes was too unsteady for the detection of the effect. Zinc has thus far shown no hissing point. Something resembling a hissing point was found with an arc in air between a mercury anode and carbon cathode, but this may have been due to disturbing causes. Lecher's assertion that the iron arc is a discontinuous discharge, while the copper arc is perfectly continuous, was put to the test for both the quiet and hissing stages. A bolometer was substituted for the hot wire used by Lecher, but it soon became evident that the capacity and self-induction of the bolometer circuit tended to set up oscillations, causing a "singing" iron arc. Good results were obtained by connecting a self-inductance of low resistance in series with the arc. The conclusions arrived at were briefly as follows: The carbon and iron arcs, when quiet, are continuous; when hissing, they are oscillatory. The copper arc seems always to be oscillatory, and the smaller the current the more is the bolometer heated. This point, as well as bolometric tests with other metals, is soon to be investigated.



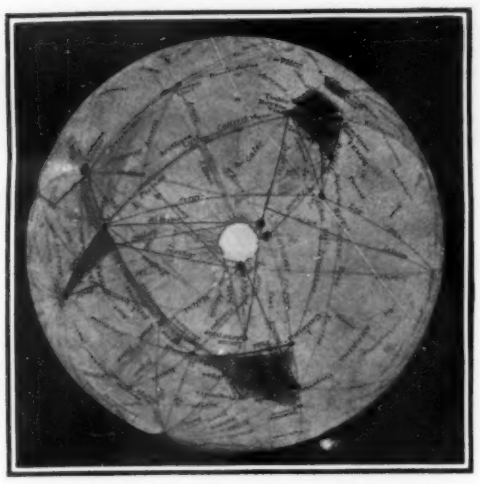
TWO SAND PAINTERS AT WORK AT BRIGHTON, ENGLAND.

SAND PAINTING.

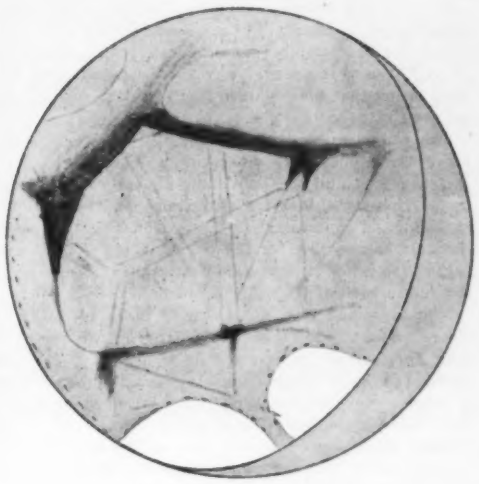
At Brighton, the English watering place, two young Englishmen devote their art to what is called sand painting. For this purpose the smooth sand of the dunes is used, and the young men thereby make a satisfactory livelihood for themselves, as the onlookers as a rule are perfectly willing to contribute something in acknowledgment of the artistic pleasure they are allowed to enjoy. Our picture shows the two painters at work. One of them is just on the point of completing Windsor Castle, while the other reproduces in the sand the portrait of the late Queen Victoria. Sand sculpture is probably familiar to most of our readers, but sand painting would certainly seem to be a new art.

THE RIDDLE OF MARS.*

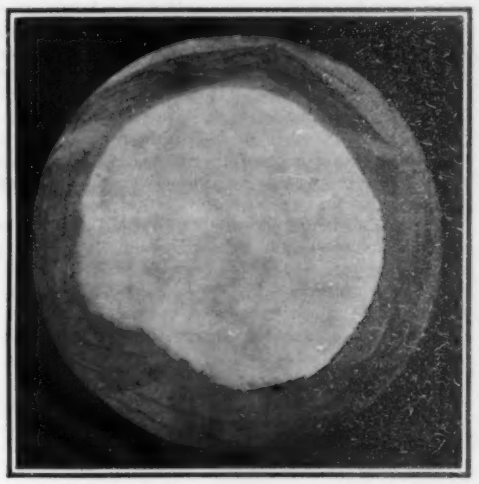
Whether or not astronomers agree with Prof. Lowell's Martian theories, it cannot be denied that he has been by far the most indefatigable observer of our planetary neighbor. His studies have been elaborate and painstaking, and have involved not only the expenditure of years of time, but the erection of a private observatory in an atmosphere peculiarly fitted for his work. Based upon this foundation, any book of his on the subject deserves somewhat more consideration than the passing review which usually falls to the lot of a popular exposition of an important scientific investigation.



The North Polar Cap of Mars.



The Double Canals of Mars.



The South Polar Cap of Mars.

In the first place, Prof. Lowell is a staunch believer in the habitability of Mars. His conclusions, reached after a minute study of the puzzling surface markings of the planet, are based on a wealth of ingenious reasoning that cannot but appeal to the romantically inclined. In the following brief paragraphs we have endeavored to present in succinct form the theory which Prof. Lowell has formulated, and the plausible arguments he has advanced to uphold that theory.

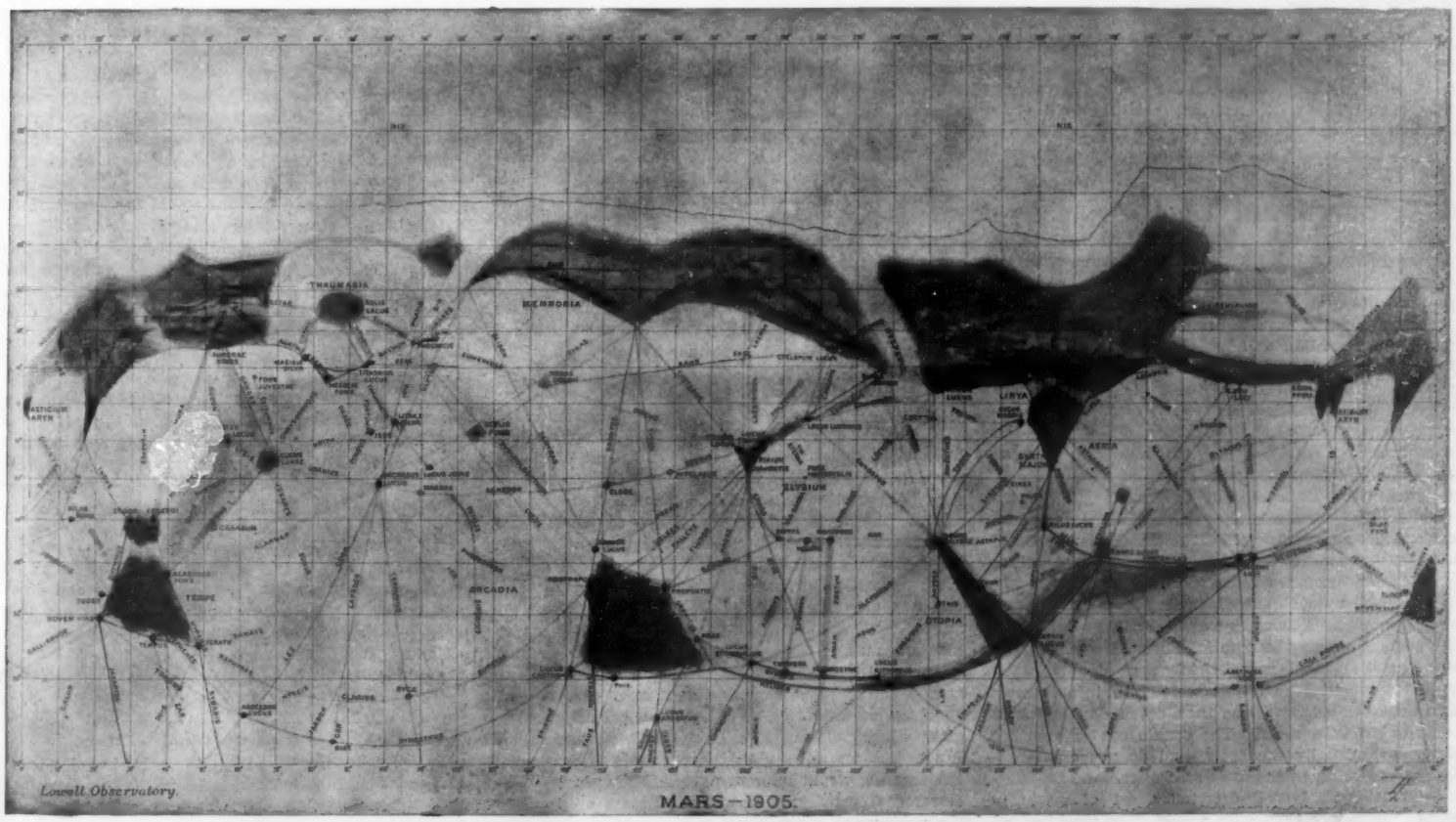
Viewed through a telescope, Mars appears as a disk crowned with white spots and covered with blue-green and reddish ocher patches. Upon the fluctuations of these markings Prof. Lowell bases his conclusions of the habitability of the planet. Most prominent of all the markings are the white spots that cap the poles. They are the most important evidence of the planet's constantly changing condition, for they come and go just as our own polar snows wax and wane. In the depth of winter they stretch over much more than the polar regions, extending down to 60 degrees and even to 50 degrees of latitude north or south as the case may be, then dwindling until, by midsummer, they extend only 5 or 6 degrees across. A three-inch glass is sufficient to disclose these modifications. It was early surmised that Martian caps must be composed of ice and snow, a theory which Prof. Lowell substantiates by pointing out that as the Martian cap melts it is surrounded by a deep blue band, which keeps pace with the shrinking cap and is clearly the product of its disintegration. This ribbon of blue conclusively shows that not gas but water is the substance of which the caps are composed.

If the caps melt, they must clearly pass into a gas, which means that Mars must have an atmosphere. That atmosphere, it is safe to conclude, is composed primarily of water vapor. Corroborative evidence of the presence of Martian air is shown by the existence of clouds, rare though they may be. Other evidence is afforded in the limb light, a phenomenon which may be described as a brilliant obliteration near the edge of the disk, an obliteration which suggests a veil drawn between us and the planet, and which can be caused only by air or haze. Evidence has also been gathered of the existence of a twilight, which would indicate the presence of a thin high air more rarefied than prevails on our highest mountain peaks. That the atmosphere must be thin is proven by the uninterrupted view of the Martian disk in all zones.

Of the blue-green and reddish ocher patches to which reference has been made, it may be stated in a general way that of the two the reddish-ocher tint predominates, occupying as it does, five-eighths of the disk. Early in the history of Martian observation the blue patches were taken for seas, and received names in keeping with the conception. Thus, we have the Sea of Serenity, the Sea of Vapors, and the like. The initial doubt of their watery nature was cast by their change in aspect, a change first noticed by Schiaparelli. The *coup de grace* to the old belief was given when Pickering and Douglass found that the dark areas were traversed by permanent lines. If the blue-green areas are not seas, what are they? According to Prof. Lowell, only vegetation can account for their singular fluctuations. He finds that in their color (blue-green) the dark areas exactly typify the distant look of our own forests. If the changes are vegetal, they must occur at the proper season of the planet's year. Generally speaking, it may be said that certain regions pass from ocher to blue-green in a few weeks at a season corresponding with the Martian spring. Conversely, the blue-green regions are converted into ocher with the coming of autumn. Mars owes its fiery tint to the great ocher stretches. Land the ocher regions have generally been taken for, and land they undoubtedly are. Indeed, they seem to be nothing but deserts. Their pure salmon hue is characteristic of the Sahara desert and of the desert of northern Arizona.

By far the most distinctive surface markings of the planet Mars are the curious streaks originally discovered by Schiaparelli and called by him "canali." They suggest a spider's web overspreading the disk of Mars. So geometric are the lines that Schiaparelli said of them, they seem to have been laid down by rule and compass. Moreover, the lines run straight throughout their course for the most part, and where they are not straight they are symmetrically curved. Equally striking is the uniform width of each line

* Mars and Its Canals. By Percival Lowell. Illustrated. The Macmillan Company. New York and London, 1907. Octavo. Pp. 393.



MARS AND ITS CANALS, A MAP MADE ON MERCATOR'S PROJECTION BY PROF. PERCIVAL LOWELL.

from its beginning to its end. Each line seems like a telegraph wire stretched from point to point. The precise width of the canals is not determinable, although certain comparative measurements made by Prof. Lowell lead him to the conclusion that 15 to 20 miles is the width of the larger of the Martian canals, and 2 or 3 miles that of the more diminutive. The length of the canals is certainly enormous. A length of 2,000 miles is not uncommon. At its terminal each canal meets other canals which have arrived with the same directness from other places. Not two, but three, four, five, and six may gather in a single point. The result is a network which triangulates the surface of the planet. To Prof. Lowell the canals are not fortuitously placed. That lines should thus meet exactly and in numbers at particular points, and only there, shows, in his eyes, that their position is not governed by accident. If very thin rods be thrown haphazard over a surface, the chance that more than two will cross at the same point is vanishingly small. Some law working to an end underlies the position of the Martian canals, according to Prof. Lowell. The departure points of the canals are not scattered haphazard over the surface, but bear general relations to its definite features. The lines emanate from well-marked indentations in the dark regions fitted by natural position for departure points, and are locally dependent upon the general topography of the fundamental features of the surface. For some reason they connect the very points most suggestive of intercommunication.

Puzzling as the straightness of the lines undoubtedly is, still more puzzling is their peculiar habit of doubling, a phenomenon also discovered by Schiaparelli. By means of the finest spider threads that could be secured, micrometric estimates of the distance between the two elements of a double canal were made at Flagstaff in 1905. The typical double canal, the Phison, is roughly speaking, 2,250 miles long; the distance between the centers of the two lines is about 130 miles, and each line is, perhaps, 20 miles in breadth. Bi-lateralism, however, is not a universal trait of the canals. Out of the 400 seen at Flagstaff, only 51 have at any time doubled; that is, one-eighth, roughly, of the whole number observed. In spite of possessing the property of pairing, a canal may not always exhibit it. The proper time is necessary. A canal seen single at one season may double at another. It appears that in some cases certainly, and possibly in all, the dual aspect is not a temporary condition, but a permanent state marked with varying intensity, the fact of "gemination," so called, being confined to a filling out of what is always there in skeleton. When the two lines of a canal differ, it is always the same one that outdoes its fellow in conspicuousness. We may, therefore, call it the original canal, the other being dubbed the duplicate. Prof. Lowell concludes that the phenomenon of variable visibility of double canals is partly seasonal and partly dependent upon the canal's position on the planet.

Seventeen years after the recognition of the canals in the light regions, canals were discovered in the dark regions. These canals left the edge of the blue-green "continents" at the very points where the canals of the light regions entered them, which continuation is highly significant, since it links the two together into a single system, compassing the whole surface of the planet. The canals run at their northern ends into dark spots at the edge of the polar cap. Here we have the end of the whole system, or more properly its origin in the polar snows.

The last phenomena to be considered in enumerating the surface markings of Mars are the so-called oases—dark, round spots toward which the canals converge in groups of three, four, five, and more. Of the spots three kinds may be distinguished: the large, the little, and the less. To the kind called the large belong the greater number of spots so far found upon the disk. According to Lowell's latest determination, the large spots measure from 75 to 100 miles in diameter. They look like sizable black pin heads sharply pronounced against the ocher stretches and even prominent in the midst of the dark areas. They all seem to be round. The little spots are distinguished from the large by being pin points instead of pin heads. They vary from 15 to 25 miles in diameter. The large spots are the places of intersection of the largest and most numerous canals, while the small spots are the terminals of the fainter lines. Hence spots and lines are connected not simply in position, but in size. In the case of a double canal, the spot is exactly embraced between the two arms of the double canal, fitting in snugly between the parallel lines. Many spots lie close together, and may be taken as double oases. Their relation to the canals which run into them is most complicated. No less than seven double canals converge in twin spots. The canals converge to the places occupied by the spots, and do not cross haphazard according to the laws of chance.

In 1894 Prof. Lowell detected a set of markings which have since been seen again. The markings in question consist of triangular nicks in the coast line of what were once thought to be the oceans. The nicks have the general form of carets, such as the markings one makes in checking items down a list. These carets punctuate points where canals are to show, or indicate terminals of those that already exist. In every case one or more canals leave the caret for their long journey down the disk. Difference of altitude, according to Prof. Lowell, is concerned in their constitution. The canal system falls to a lower level at the carets and triangular spots instead of round ones are the result.

Prof. Lowell devotes an entire chapter to the photographing of the canals by Lampland in 1903, a feat for which the photographer deserves all praise, inasmuch as it disposes forever of any theory based upon the supposition that the canals are optical illusions induced by eye-strain or the like.

The canals undergo fluctuations of a periodical nature. Sometimes they disappear temporarily. On occasion canals and whole regions appear to be blotted out. Each canal has its own times and seasons for exposing and concealing itself. Seasonal changes seem the only explanation for the phenomenon. The canals begin to develop after the greatest melting of the polar cap has occurred. This development proceeds down to the equator, and then not stopping there advances up the latitudes of the other hemisphere. In the Arctic region development is arrested as it begins to get cold there, the most northern canals being affected first. A similar wave of evolution occurs from the opposite pole some time before and passes away. To Prof. Lowell, the disappearance is due to the withering of vegetation in the autumn. Similarly, the reappearance of the canals is accounted for by the growth of new vegetation in the spring.

The oases are also subjected to change, and apparently in the same manner as the canals. They grow less evident at a like season of the Martian year, decreasing gradually in size. Like the canals, latitude together with the suitable season of the planet's year are the determining factors of their development. Each polar cap runs through a gamut of change in a Martian year; the canals also complete their cycle of growth and decay in a Martian twelvemonth. The only difference between the two is that each polar cap has but one maximum and one minimum in the course of this time, while most of the canals have two of each, though neither the maxima nor the minima are alike. Not only is the period of the two series of changes the same, but the one follows the other; for the development of the canals does not begin until the melting of the polar cap is well under way. As the polar cap disintegrates it gives rise, as we have seen, to a dark belt of blue-green, which fringes its outer edge and retreats farther as it shrinks. After this belt has been formed, the canals nearest to it proceed to darken, and those a little farther off follow suit, and so the wave of visibility rolls in regular routine down the disk. Here, then, at the outset, we have a chronological connection between the two phenomena; disintegration of the cap after integration of the canals.

The caps are undoubtedly composed of water. The development of the canals may further be ascribed to the unlocking of the polar snows. Considerable time intervenes between the disappearance of the cap and the appearance of the canals. A quickening due to vegetal growth would produce the counterpart of what we see. If we suppose the water accumulated in the cap to percolate toward the equator, starting vegetation in its course, this would explain the increased visibility of the canals, and at the same time the seeming delay by allowing for the time necessary for this vegetation to sprout. This explanation is certainly most satisfactory. The vegetal quickening would pass down the planet's surface, and give rise to what we characterize as seasonal change.

It appears that much at least of the surface of Mars has two seasons of vegetal growth, the one quickened by the north polar cap, the other by the south. How far the polar spheres of action overlap it is not possible at present to tell, as the canals at the last opposition were visible only to 35 degrees south latitude.

If vegetation exists on Mars, as Prof. Lowell would have us believe, we are at once introduced to the probability of life on that planet. The existence of a flora is ground for suspecting a fauna.

From the standpoint of any planet, the evidence of animal existence must be difficult to detect. Not until the creatures have reached a certain stage in evolution will their presence become perceptible; and not then directly, but by their handiwork. When the animal has learned to dominate nature, he will betray his existence. If we could view the earth from a distance of 35,000,000 miles, the distance which separates Mars from us during this month of July, we should know ourselves by our geometrical design. The great wheat fields of Kansas and Dakota, fields turning in hue for miles with the rhythmic procession of the seasons, would impress us. On Mars we find ourselves confronted in the canals and oases by precisely the appearance which the planet should show if it is an inhabited world. Here in these straight lines and rounding spots we have spread out e[illegible] of effort and our lines of communicat[illegible] or the oases are clearly ganglia to which the can[illegible] play the part of gulfs. The strange geometric arrangement proves inexplicable on any other hypothesis. Dearth of water is the key to the character of the canals. The only available water on Mars is that coming from the semi-annual melting at the one or the other cap of snow. Vegetation cannot start until this water reaches it. Consequently, though the sun be ready, vegetation must wait on the coming of the water, and starting from near the pole, proceeds equatorward. As a planet ages it loses its oceans, and gradually its whole water supply. Life upon its surface is confronted by a growing scarcity of this essential to existence. That is the condition of Mars. If there are intelligent beings on Mars, they must find some means of conducting the scant supply of water from the poles to the centers of population. Such signs of conscious interference with nature Prof. Lowell finds in the canals. The canals are drawn with such mathematical precision that to him they seem designed for the purpose.

In support of this theory he argues that the positions of the canals with regard to the main features of the disk are remarkable. The lines not only leave important geodetic points, but they travel directly to equally salient ones. Oases are found only at junctions of the canals, which, in Prof. Lowell's opinion, proves that they are the terminal points of the canals.

Most remarkable is the system which the canals form. They are most wonderfully inter-connected. The system covers the whole surface of the planet, dark areas and light areas alike, in a way that renders impossible the supposition that any natural force produced the canals. The system, after meshing the surface in its entirety, runs straight into the polar caps. To Prof. Lowell it is an irrigation system whose aim is the tapping of the snow caps for the water there released, and then its distribution over the Martian disk.

Savage Eyesight.

Many people believe, because they have read in books, that the sight of the Indians was extraordinarily keen, and that they were able to descry objects at a greater distance than was possible for white men. This is an error, if the assertion is to be taken without qualification. All savages have eyes trained to see those things that are necessary to their preservation—game and enemies. Their sight is not by nature more acute than that of the white man, but in some respects it was better trained. The whites who lived among the Indians and were compelled to defend themselves against their enemies saw just as far as their enemies. It may be affirmed as a general principle that there is nothing a civilized man cannot do better than a savage. The latter uses his reason to aid his instinct; the former makes his instinct subservient to his reason. It is well known that sailors are able to discern objects at sea at a greater distance than landsmen, but we have to do here with a faculty that any one can acquire. The Indians did just what the whites who lived among them did who subsisted on game and were obliged to be on the constant lookout for enemies. Both had acquired not merely the power to discern objects, but also training in the interpretation of the signification of those objects that came within visible range. It is probable, for reasons given above, that not only the Indians as well as all tribes living on the same social level, but also the backwoodsmen, retained their sight to a more advanced age than is now generally the case; but that the eye of the former was naturally more powerful than that of the present generation or that of men in general is unsupported by trustworthy evidence. There is no doubt that a child born with normal eyes in one of our large cities can see objects just as far off and define them just as accurately with proper training as a person who never saw a dozen houses together. It is well known, too, that what are sometimes called the lower senses—touch, taste, and smell—are often of extraordinary acuteness in civilized man as the result of training. If, therefore, any of the senses of our urban population is feebler than that of the dwellers in the rural districts, it is not due to an inherent weakness, but to improper or injudicious use.—Dr. C. W. Super in the Popular Science Monthly.

An experimental railroad for testing signaling devices, materials used in track construction and different types of motor cars for railroad use, has been built by the railway department of the German government. The road is double-tracked and is oval-shaped, having a length of 5,760 feet. The straight track is about 800 feet long.—Engineering Record.

Photographing the Canals of Mars.

Prof. Percival Lowell, Director of the Lowell Observatory at Flagstaff, Ariz., has telegraphed as follows to the Harvard College Observatory: "Todd of the Lowell expedition to the Andes cables Mars canals photographed there by Slipher."

Correspondence.

Railway Curve Mechanics.

To the Editor of the SCIENTIFIC AMERICAN:

As a criticism of the suggestion of your correspondent, in the SCIENTIFIC AMERICAN of June 22, I would call attention to the fact that the slipping of wheels on curves is the resultant of two components, a longitudinal one due to the greater length of the outer rail and a transverse one due to the condition that but one axle in a rigid wheel base can take a radial position. The greatest slipping effects are produced by the long, rigid wheel bases of locomotives, and the independent mounting of the wheels would reduce the sliding but very little. In the case of driving wheels differential gears would be required; and the additional machinery would be a source of danger, while the space required for it would seriously impair the efficiency of the locomotive. This is a subject which has received mathematical study and experimental investigation from the early days of railroading. G. E.

Improvised Fans on Machine Tools.

To the Editor of the SCIENTIFIC AMERICAN:

Yesterday I saw at work in the standard plant of the American Radiator Company, Buffalo, two improvised fans attached to a large milling machine. The operator of the machine, Mr. George Gebhardt, fastened on each of two rapidly rotating shafts a piece of tinned sheet iron, forming a fan about 12 inches long and 8 inches wide. The tin plate was simply curled as closely about the shaft as possible, then tightened by means of a wooden wedge. The shafts rotate about 300 times a minute, hence the fans cause a delightfully cool breeze, which not only cools the operator, but also blows away the iron dust from his presence. Thus the operator need inhale but little of such dust.

It seems to me that many thousand machine tenders in the land might profit by imitating this truly simple, useful and cheap device. The fan does not cost three cents.

Mr. Gebhardt also proposes to place similar but larger fans at intervals on the main line of shafting in shops. JAMES ASHER.

Buffalo, N. Y., June 25, 1907.

Oral Method of Teaching the Deaf.

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest the article in a late issue of the SCIENTIFIC AMERICAN regarding the oral method of teaching the deaf. In the main, the article outlines the course usually pursued in all the schools of our land. However, the article gives apparently as the first sample sentence, one a trifle more difficult than is usually used. A simple sentence, with an intransitive verb, is hard enough for the first effort. Show the boy that he is to run, and teach him to write "John ran." This is a simpler matter than the sentence form given in the article. It has always been next to impossible for one not a teacher of the deaf, as the author of the article in question, to get through without making some statement about the deaf that provokes a smile on the part of the one who is familiar with the real work of teaching them, and the article in question is no exception. We do not read far in it till we come across this curious statement: "The old-fashioned finger alphabet is unknown in up-to-date institutions." Any one who is familiar with the largest and best-equipped schools in this country would characterize that as a very great mistake; one of the most modern and most successful schools in the land, in Rochester, N. Y., has a reputation as wide as the continent for turning out pupils who, in the language of that critic, Mr. Pach, of photographic fame, "know their English to the limit," having built up its name on the basis of the manual alphabet. It would be a rash writer who should say that the Rochester school did not pay proper attention to the teaching of articulation!

And what is to be thought of the claim that the four or five other schools supported by the State of New York are not up-to-date?

But the New York schools do not rank any higher than those of Ohio, Michigan, Illinois, Kentucky, Iowa, and so on along the line.

Further along in the article referred to, the statement is made that congenital mutes are so taught that at the end of their course their articulation would not lead one to think that they were deaf! Giving those of us who are doing our best to teach these children credit for all in the way of articulation that we have ever claimed, you will not have to allow us so much as that. The congenital mute who does not betray by his utterance that he is deaf, must be talking to some one whose perception is remarkably dull.

The teachers of the deaf do not make any such extravagant claims as that, but when some outsider is called in to view their work, he gets to where he thinks he must make his statement a trifle stronger than he has been told, to make it effective. These exaggerated statements do us no good, but rather tend to discredit our work. We are trying to accomplish what we may, but there are some things that we have not yet attained and some that we are not likely to. Hence these remarks. H. C. HAMMOND.

School for the Deaf, Olathe, Kansas.

Liquid Specula.

To the Editor of the SCIENTIFIC AMERICAN:

Upon reading the article by Mr. A. W. Nightingale in SCIENTIFIC AMERICAN of December 29, 1906, on the use of liquid specula for telescopes, it occurred to me that perhaps the readers of your paper would be interested in the mathematical solution of the problem, which I am giving below. The same method was used by Mendeléeff, who rotated masses of melted speculum metal and allowed it to cool while rotating, thus producing the required surface—a paraboloid of revolution. The solution of the problem is as follows:

Consider the elemental prisms drawn in the section $X\ Z$ of the surface. Since, in a liquid, the pressure at a point is equal in all directions, we may equate the centrifugal force of the horizontal prism to the liquid pressure of the vertical prism at the point P.

Now, consider an elemental volume of length dx, width dy, and height dz. We will integrate only in the X direction, and so dy and dz will be constants.

Volume $= dx\ dy\ dz$.

Mass = volume × density $= D\ dx\ dy\ dz$. D = density of liquid. Centrifugal force $= \frac{MV^2}{Rg}$. $v = wx$ where w = the angular velocity. Centrifugal force =

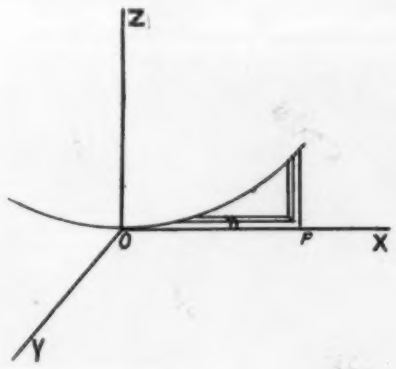
$$\int_{R=0}^{R=x} \frac{D\ dx\ dy\ dz\ (wx)^2}{xg}$$

Since D, dy, dz, w^2, and g are considered constant, they may be placed outside the integral sign or centrifugal force =

$$\frac{D\ dy\ dz\ w^2}{g} \int_{R=0}^{R=x} x\ dx = \frac{D\ dy\ dz\ w^2 x^2}{2g} \qquad (1)$$

The liquid pressure vertically will be equal to the volume times the density $= dy\ dz\ Z\ D$. (2)

dy and dz are used as dimensions of the vertical



prism, since evidently it must have the same cross section as the horizontal prism.

Equating (1) and (2) we have:

$$\frac{D\ dy\ dz\ w^2 x^2}{2g} = dy\ dz\ Z\ D \quad \text{or} \quad Z = \frac{w^2 x^2}{2g}$$

$x^2 = \frac{2g}{w^2} Z$; hence the curve is a parabola.

Comparing with the ordinary equation, $x^2 = 2pz$, $p = \frac{g}{w^2}$. Since the distance from the focus to the vertex $= \frac{1}{2}p$, and this distance is also the focal length, we have the focal length $l = \frac{g}{2w^2}$.

Changing from angular velocity w to revolutions per second n, we have, since $w = 2\pi n$—

$$l = \frac{g}{2(2\pi n)^2} = \frac{g}{8\pi^2 n^2} \text{ hence } n = \sqrt{\frac{g}{8\pi^2 l}}$$

Using this result in the solution of a practical problem, let us suppose we wish to make a mirror of focal length 50 feet.

$$n = \sqrt{\frac{32.2}{8\pi^2 50}} = 0.1133 \text{ rev. per sec. or 1 rev. in 8.82 seconds.}$$

For a focal length of 20 feet $n = \sqrt{\frac{32.2}{8\pi^2 20}} = 0.565$ rev. per sec. or 1 rev. in 1.77 seconds.

It is, of course, quite probable that it would be impossible to rotate the mirror steadily enough to prevent the formation of ripples on its surface, and these would ruin its value as an optical instrument. Also, it is improbable that the earth itself is free enough from tremors to avoid the same difficulty. The mirror could only be used in a vertical position; however, rays from other directions might be reflected into it by plane mirrors. WILLIAM C. WOODLAND.

Warren, O

Progress on the Culebra Cut.

To the Editor of the SCIENTIFIC AMERICAN:

I have read lately a very concise and clear article by Roy D. Hunter on "The Panama Canal in April, 1907," in which he states that in the month of last November about 422,000 cubic yards of earth and rock were removed; in March of this year 815,000 yards; in April 879,000 yards, and that hereafter the amount excavated will probably be 1,000,000 cubic yards per month. That on the 1st of last May there remained 51,000,000 cubic yards to be excavated in the Culebra Cut, which is nine and one-half miles long, and in which fifty-three steam shovels are at present at work making the progress stated. If these are the facts it appears that the Culebra Cut—which is the part of the canal requiring the most labor and time to construct—will probably be completed in fifty-one months from the first of May last.

If this be so, I would ask, Why cannot the number of steam shovels be doubled and the canal be completed in twenty-six months? This would give to each shovel a section of the cut 473 feet in length, which it would seem would be sufficient room for the shovel to be worked its full capacity.

It would then be only a question of sufficient cars, locomotives, switches, railroad tracks, and men to take care of the dirt put out by the doubled number of shovels. This is assuming that the three dams and the locks could each be completed as soon as the great Culebra Cut can be finished—and this is taken for granted by the present layman inquirer.

Will not the advantage to the nation by this shortening of the time of the completion of the canal ready for use and for a possible contingency of national necessity in case of war, be so great as fully to justify the use of all reasonable means to hasten the work? That is the way it seems to A LAYMAN.

Trinidad, Colorado, June 22, 1907.

[It is now considered by the engineers of the canal that the determining factor, as to the time of completion of the Panama Canal, is the Gatun Dam and Locks, and not the excavating of the Culebra Cut.—ED.]

The Current Supplement.

The current SUPPLEMENT, No. 1645, contains among other articles of interest, a contribution on gypsum plaster and gypsum products as building materials, crammed with much valuable technological information. The "Psycho-physical Aspect of Climate" is the title of an article which gives a psychological reason why Englishmen and New Englanders talk about the weather. The three articulated compound locomotives now in course of construction for the Erie Railroad will be the heaviest and most powerful locomotives ever built. The engines are described and illustrated in the current SUPPLEMENT. Alfred Sang contributes a paper on the art of galvanizing. The aeronautical observatory recently erected near Lindenberg, Germany, is destined to become a center for the investigation of the atmosphere by means of kites and balloons. For this reason Dr. Alfred Gradenwitz's article on the observatory, illustrated as it is with many excellent pictures, should be read with interest. The interest aroused by the exhibition of the model of the Brennan monorail car renders the moment opportune for a few elementary notes on the theory of the gyroscope. For that reason an article on the gyroscope will be found in the current SUPPLEMENT. In two lectures delivered at the Royal Institute, H. F. Newall, president of the Royal Astronomical Society, gave an interesting review of the state of our knowledge of stellar spectroscopy. These lectures are condensed in the current SUPPLEMENT. René Bache describes and illustrates Venomous Insects. The Artificial Dispersion of Fog is a subject discussed by M. M. Dibos. S. P. Fergusson writes on meteorological phenomena of mountain summits.

Peary Delayed.

Commander Robert E. Peary will not start for the North Pole until the middle of July. Delay in getting the steamer "Roosevelt" ready made it necessary to postpone the date of sailing.

The repairs to the "Roosevelt" have been more extensive than expected. Among the alterations is the installation of four new boilers. With these, Commander Peary said, he hoped to make up four or more days in his run to North Grantland. He will have to hurry to get into quarters before the Arctic winter sets in. The size of the forecastle is being increased, so that it will extend from the topgallant forecastle to the forward part of the main hatch, and will accommodate a greater number of Esquimaux than on the previous runs.

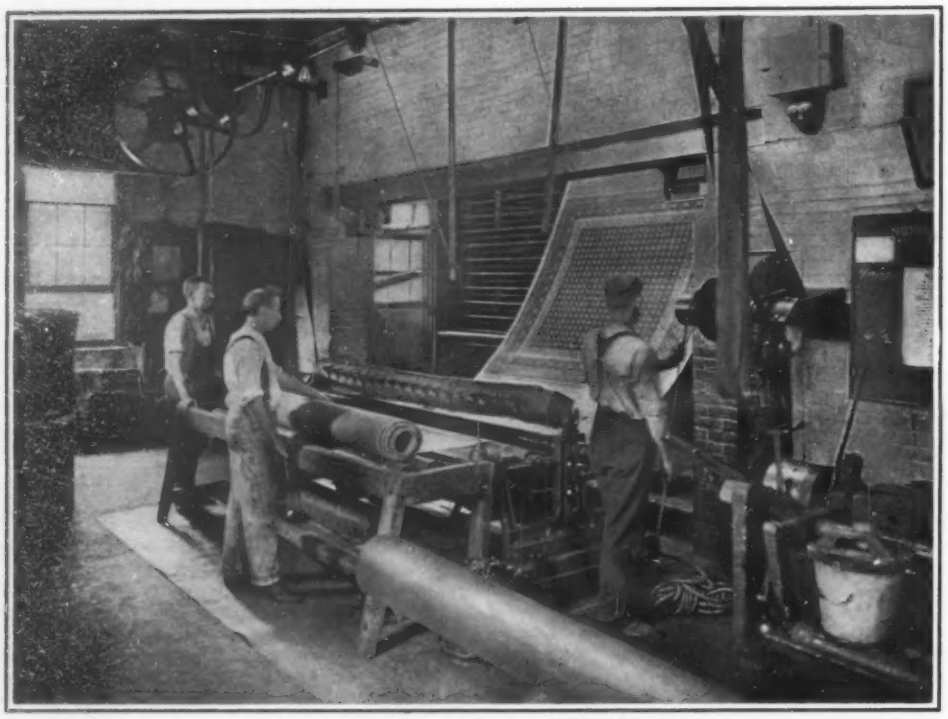
HOW LINOLEUMS AND OILCLOTHS ARE MADE.

In the year 1804, so the story goes, there lived in England a painter, John Buckley by name, whose business it was to paint designs, or rather a design (his artistic endeavors being limited to the painting of large black and white diamonds) on wooden floors. But a serious obstacle to his success lay in the fact that the paint took too long to dry, entailing considerable inconvenience and occasionally loss of business to his patrons. In his efforts to find a remedy for this evil, Buckley hit upon the plan of painting the design on canvas and allowing it to dry before laying it on the floor. He put his idea into practice, and although, to be sure, the result was crude as compared with oilcloths of the present day, the idea took, and the oilcloth industry was born.

The facility with which this painting on canvas could be accomplished suggested a wider range of design, and for some time stencils were used with very good effect. Then the designs were cut on blocks, substantially as at the present time, and printed on the canvas.

The first oilcloth made in this country was in Philadelphia, in the year 1807, by one John Dorsey, but the first manufacturer of any consequence was Isaac Macauley, who took over Dorsey's little shop and built up an important business from it. Only by the shrewdest financial ability and business acumen did Macauley succeed, for many years, in staving off financial disaster, so great was the cost of manufacture and so slight the demand, but finally in 1837 his long fight came to an end, and Thomas Potter, of Philadelphia, purchased the plant, which was then located on Spring Garden Street, and was known as the Bush Hill Oilcloth Factory. This date marks the establishment of what is now the oldest and largest factory for the making of oilcloths and linoleums in America—a plant occupying an area of a little over ten acres, and comprising more than fifty buildings.

Section of the Block Department. Here Designs Are Originated and Printing Blocks Made.



Varnishing Machine. The Oilcloth Passed Through a Trough of Varnish in the Machine and Thence into the Heater.

In those early days the canvas backing for oilcloths (linoleums being then unknown) was spun from flax grown in Pennsylvania, and was sized (the process of filling up the interstices of the canvas with a paste-like substance preparatory to being treated with subsequent coats of paint or priming), primed, and printed by hand, then hung up to dry by natural heat. This slow method made the oilcloths very expensive, as the manufacturers were entirely dependent upon weather conditions for results. The canvas or burlap was made into sheets of 60 feet by 21 feet, and it took a year and over to make a piece of oilcloth ready for the market. From this it will be appreciated that only the very well-to-do could afford so expensive a luxury.

This hand method of making oilcloths continued in vogue until 1865, when new methods were introduced for sizing and coating the goods, and artificial heat came largely into use for drying purposes—improvements which resulted in placing the goods within the reach of the general public. Then came the invention of linoleum in England in 1868. Other milestones in the progress of this industry are the invention of a machine for printing oilcloths and linoleum and a machine for making inlaid linoleum. These machines will be presently described.

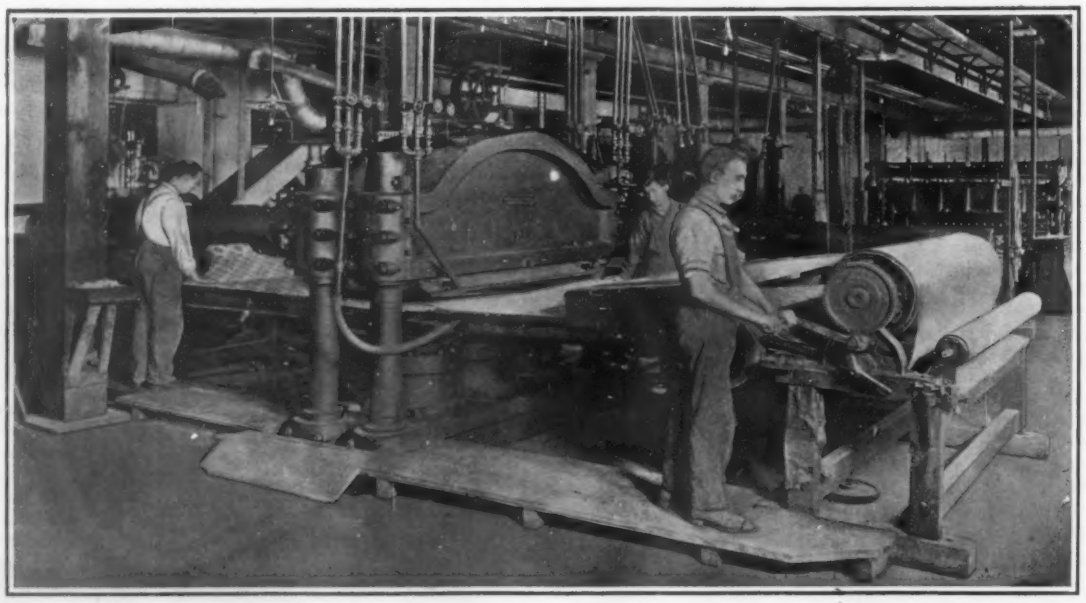
To those who may be unfamiliar with the difference between linoleum and oilcloth, we will say that while the latter consists of burlap treated with numerous coats of paint, linoleum, on the other hand, consists mainly of linseed oil boiled to a rubber-like consistency and mixed with gums and cork dust, which compound is rolled in a thick layer on a backing of burlap.

HOW LINOLEUMS ARE MADE.

Before proceeding further it is necessary to state that linoleum is made in three grades, namely, the "straight-line-tile inlaid linoleum," the "granulated or molded inlaid," and the "printed and plain linoleum." We will describe first the process of manufacturing the finest grade or straight-line-tile inlaid linoleum. The linseed oil is boiled in large pots mounted on trucks, which are run over open brick fireplaces. Here the oil is boiled for several hours, or until it reaches the proper consistency. Great care is exercised to prevent the oil from boiling over, for such an accident would result in a conflagration. From time to time the oil is stirred, and a spray of water is used to make the boiling fluid subside. Every facility is provided for confining the fire to a single pot should it boil over, and for drawing the pot into a fireproof inclosure, where it may burn without damage to the surrounding buildings.

After the oil has been thoroughly boiled or oxidized, the next process is to make it into "skins." Several large buildings are set aside for this work. Each building is filled with canvas sheets hanging parallel about four inches apart from a rack at the top of the building. The oil is poured over these sheets from a carriage mounted to travel over the track, and thus a gummy layer is deposited on the canvas. The temperature of the room is kept at about 165 deg. F., so as to prevent the oil from gumming too rapidly, and to insure an even distribution over the canvas sheets. The sheets are flooded twice a day until a layer of oil has accumulated to the required thickness. In about four or five weeks the skins are ready to be cut down.

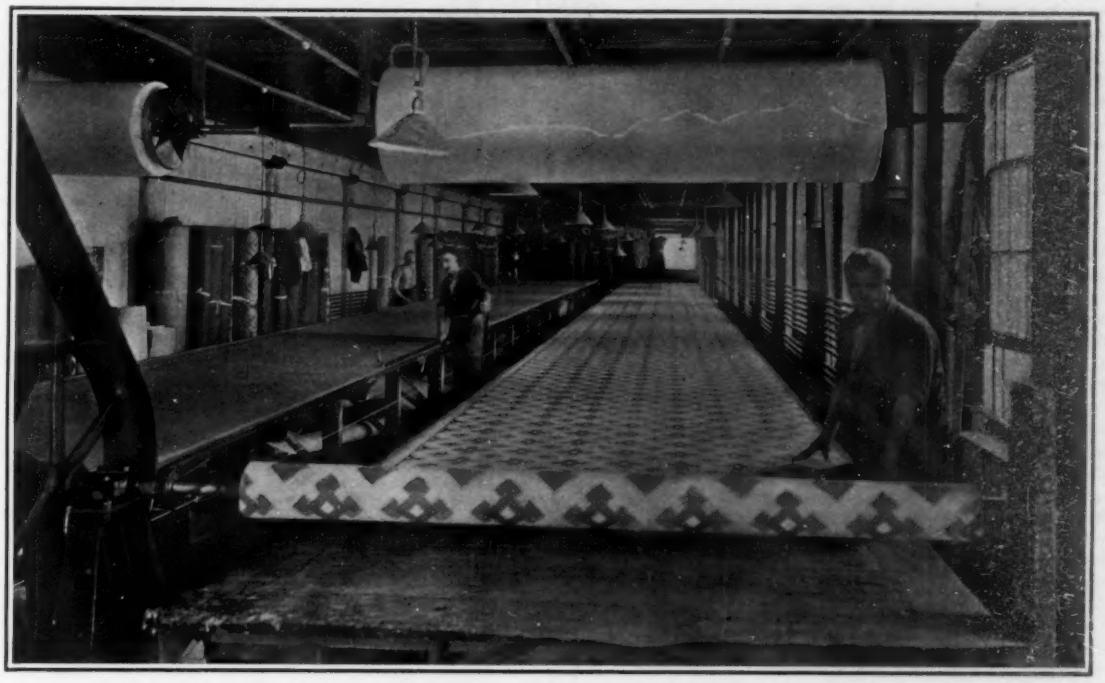
The next step is to pass the skins through the grinding machine. This consists of two smooth steel rollers, between which the skins are ground into butter-colored flakes. The flaked oil is mixed in a hot kettle with rosins and gums, and formed into large blocks of a soft, rubber-like consistency. It is then passed through what is known as a "German mixer." This machine grinds the oil and thoroughly mixes it with powdered cork and wood pulp, at the same time adding the required color pigment. The compound is then run through calender rolls, and made into sheets about 18 inches wide by ¼ inch thick. These sheets while in a soft, gummy condition of a consistency not unlike fairly stiff workable putty are placed in the inlaying machine. The inlaying machine is equipped



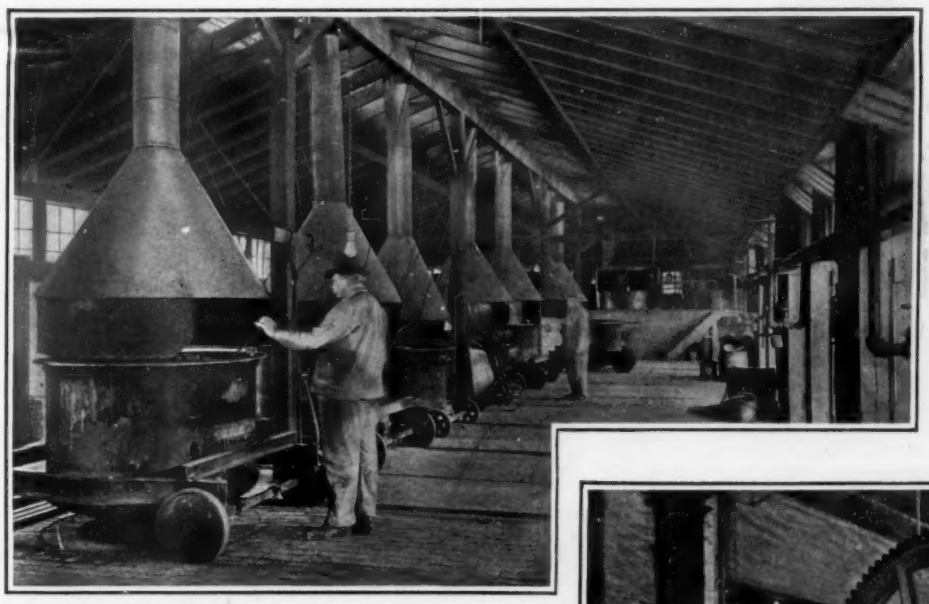
One of the Huge Hydraulic Presses Used in the Manufacture of Straight-line-tile Inlaid and Molded Inlaid Linoleums.

with dies corresponding in shape to the various forms called for in the design. It is provided with a separate die for each color. These dies operate simultaneously to stamp out the different shapes or tesseræ in their respective colors, and adjust them in their proper positions on the prepared burlap. It will be understood that the dies are arranged one behind the other, and operate independently over their own respective portion of the burlap, the latter being moved forward after each operation of the dies to the next successive die to receive the next shade of tessera. The dies are operated by hydraulic pressure, and exert only sufficient pressure on the tesseræ to make them cling to the burlap. This machine marks an important advance over previous methods of making inlaid linoleum. As heretofore done, the tesseræ are stamped out individually in various dies, and then arranged by hand on the burlap. Obviously, the inlaying machine materially reduces the time required for this operation. The inlaying machine, it may be stated, was designed and built by the Thomas Potter Co., which has a patent on it, and the machine we illustrate on the front page is the only one of its kind in the world.

From the inlaying machine the goods pass to a hydraulic press, where, after being thoroughly inspected to replace broken tesseræ or repair any defects, it is subjected to a pressure of 3,000 pounds to the square inch twice in succession. This tremendous pressure effectually squeezes the stamped-out tiles and the burlap into one homogeneous sheet without seam or joint anywhere. After this the goods are drawn into a heater (a room equipped with hundreds of racks 90 feet long, and arranged one above the other about 8 inches apart) and there left under an approximate temperature of 145 deg. Fahr. for four or five weeks until cured. This process renders the linoleum extremely tough and elastic, with a wearing quality that is little short of marvelous. After a final inspection to discover any defects, the goods are stamped and prepared for shipment.



Inspection Tables Where Goods Are Carefully Examined for Defects Before Being Made Ready for Shipment.



Section of Oil-Boiling Department. The Linseed Oil is Boiled to a Gelatin-like Consistency.

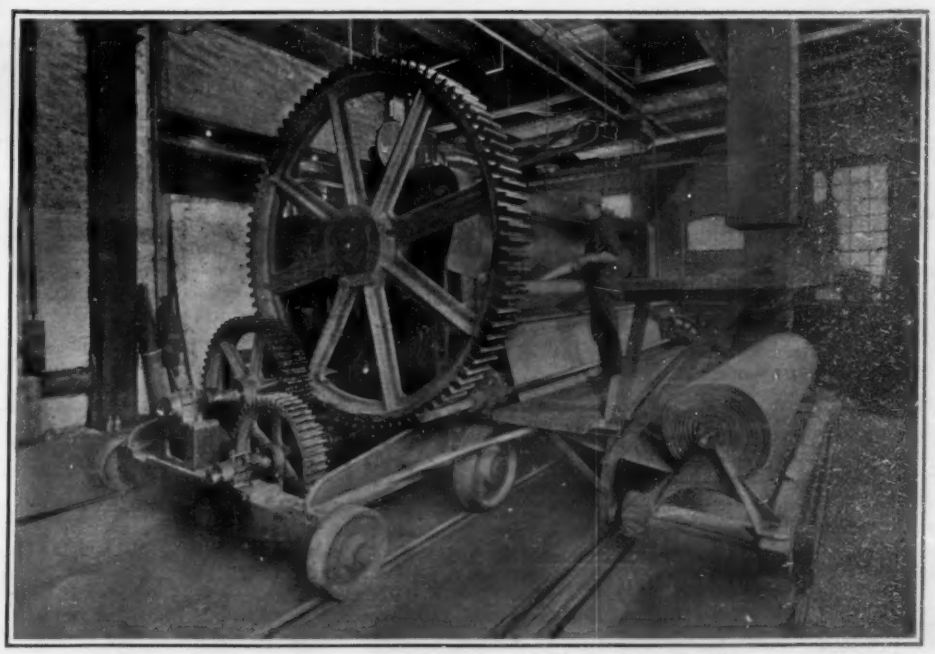
The burlap used in making this, as well as the other grades of linoleum, and the oilcloths, is imported from Dundee, Scotland. In preparing the burlap for linoleums, it is first run through a coating machine, which lays on a coating of red paint, known as backing; then it passes into a heater, a large room 65 feet high, where it is suspended from the ceiling in closely arranged folds, and left over night in a temperature of about 150 deg. Fahr.

GRANULATED OR MOLDED INLAID LINOLEUM.

In the making of molded inlaid linoleum, instead of rolling the material as it comes from the "German mixer" into sheets, it is passed through a machine known as a scratcher, which reduces it to a granulated form. The granulated matter is then placed in a sifter, in which a series of revolving arms beat the material through a screen. The linoleum compound is similar to that used in the best grade, though of a slightly cheaper quality, but the method of manufacture makes the finished product considerably cheaper, although at the same time rendering its wearing quality inferior to that of the straight-line-tile inlaid grade. The designs ordinarily used in this grade of linoleum are composed of a series of diamonds arranged to form various patterns. A plate perforated with diamond-shaped openings and having somewhat the appearance of a lattice is used as a mold, through which the granulated material is sifted on to the prepared burlap. To separate the various colors into their respective diamonds as called for by the pattern, a series of pans are laid over the mold, each pan being provided with selective openings that register with the openings in the mold which are to receive granulated material of a particular color. After this color has been sifted into the molds, another pan is set in place as a template for the next color, and so on for as many colors as may be desired. After the entire mold has been filled, it is lifted from the canvas, leaving the granulated linoleum arranged in the desired pattern. This is then subjected to hydraulic pressure, as in the case of the best grade inlaid, and is thus pressed into the burlap backing. The difference in the method of manufacture between the two grades is worth noting. In the case of the straight-line-tile inlaid, the linoleum composition is first rolled into concrete sheets before being stamped out, and is pressed into the burlap while in a soft cohesive condition under heat; while in the case of the molded inlaid type the material is granulated, not rolled, and is then subjected to hydraulic pressure, producing a texture of a more open and coarse nature and, consequently, to a much greater extent disintegrable. The molded linoleum may be readily distinguished from the straight-line-tile by the ragged edges of its design. It is estimated that if a piece of molded inlaid linoleum will last five years on a given floor, the straight-line-tile inlaid will last twenty years.

PLAIN AND PRINTED LINOLEUMS.

In the making of plain and printed linoleums primed burlap is used. The linoleum composition is applied to the burlap by passing it with the burlap between large calender rolls measuring 160 inches across the face and weighing about 15 tons apiece. The quality and thickness of the different grades are regu-



One of the Calendering Machines. The Weight of This Machine is About 80 Tons; the Rolls Measure 160 Inches Across the Face.

HOW LINOLEUMS AND OILCLOTHS ARE MADE.

lated by the distance between the rolls. After passing through the calender the coated burlap is drawn into the heater, where it remains several days under a temperature of about 160 deg. Fahr. Much of this linoleum is sold plain, but that which is to be printed takes its course to the printing room, where it runs through a machine that lays on the required designs in colors.

The invention of a printing machine for linoleum marks one of the most important improvements in the industry. Many experiments were made along this line, but it was not until the year 1892 that a successful high-speed printing machine was built, and this was installed at the Thomas Potter Company's plant in Philadelphia, Pa. This machine proved such an unqualified success, that it is being used to-day without any material change. It has a range of from three to nine colors, working on an area of about 120 square yards at one time, completing 18 inches of the design, full width, at each impression, and printing about 24 square yards a minute. In the old-fashioned way of hand printing, two men working together could print about 150 square yards per day. Now, each machine produces approximately 8,000 square yards daily, doing the work of over 100 men.

After leaving the printing machine, the goods pass into a heater, and are left there under a temperature approximating 145 deg. Fahr. until thoroughly cured and ready for the market In this connection it might be well to mention still another grade of linoleum known as "cork carpet." As the name implies, this grade is composed of linoleum composition with a much larger percentage of cork, and is made in greater thicknesses than the plain linoleum.

In the early days the use of linoleum was confined almost entirely to kitchens and vestibules of private residences, but as years passed, its wonderful utility became more widely known and appreciated until to-day we find it on the decks of modern men-of-war of all nations, steamships, pleasure boats of all descriptions, automobiles, parlor cars, hospitals and sanitariums, dining rooms, cafés, colleges and Sunday schools—in fact, its uses are too varied to enumerate.

THE MAKING OF OILCLOTHS.

The burlap used in oilcloths is first drawn through a sizing machine, which applies a substance to fill up the interstices and prepare the surface for the priming which follows. After the priming the burlap is dried in a heater, and it is then ready to receive the coatings of red paint. These coatings (from three to five according to the quality of oilcloth to be made) are applied by machinery, the burlap being passed under a knife blade, set by screws, which distributes the paint evenly and regulates the quantity. After each coat the goods are run into the heater, and dried before receiving the succeeding coat. This done, the prepared burlap is passed through a pumicing machine, which makes the surface smooth for the printing. The process of printing the design on the oilcloth is done in the same way and with the same machinery as in the linoleum. After the printing the material is again put in the heater to dry, and then taken to the varnishing machine to receive a finishing gloss. The oilcloth is now passed into the drying room, where it is dried in a few hours.

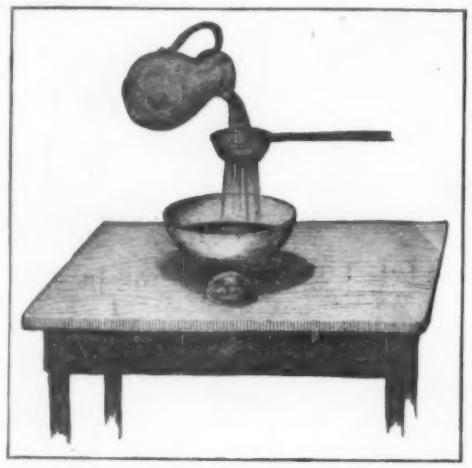
HOW TABLE COVERS ARE MADE.

Unlike the floor coverings, the foundation of table and enameled oilcloth is cotton sheeting. The rolls of cotton are first run through a calendering machine, and then given several coats of a compound consisting of linseed oil and China clay, with the necessary ingredients to give the desired color. The goods are run into a heater to be dried after each coating. When the several coats have been applied, the goods are passed through a pumicing machine, which removes all rough particles from the surface. The printing machine is a cylinder printing press, similar to those used in the manufacture of wall papers and cotton prints. The designs are etched on copper-covered cylinders, each cylinder carrying a certain color and part of a design. The final stage of the operations is to pass the material through a varnisher, then into the drying room, where it is left for twenty-four hours, when it is ready for the market.

The Siamese Minister of Public Works has received the sanction of the king to the proposal to acquire and construct an entirely up-to-date telephone system in Bangkok. The system decided on is the central-battery system. The minister is now engaged arranging for a new cable from Koh-Si-Chang to Sirachi with connection to Bangkok.

SOME INTERESTING TRICKS.

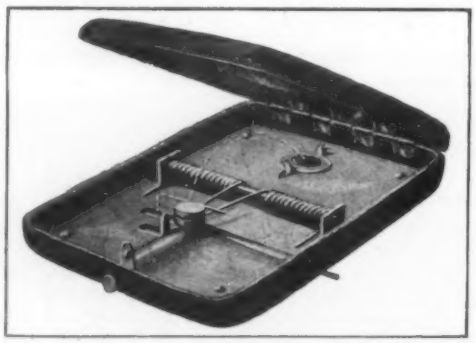
A few little parlor tricks often while away time which would otherwise hang heavy on the hands. One of the best we have seen recently is the "magic sieve." An ordinary wire-cloth sieve with a handle is shown to the larger or smaller audience, but they do not see a celluloid shell which conforms to the bowl of the sieve.



The Magic Sieve.

In performing the trick the celluloid shell is placed out of sight at the back of the bowl. Water is poured through the sieve into the bowl, and it is deposited face downward on the table over the celluloid shell. Both are picked up together and the water refuses to leave the sieve. Both the celluloid shell and the water are turned into the bowl, and the liquid passes through as before, to the mystification of the audience.

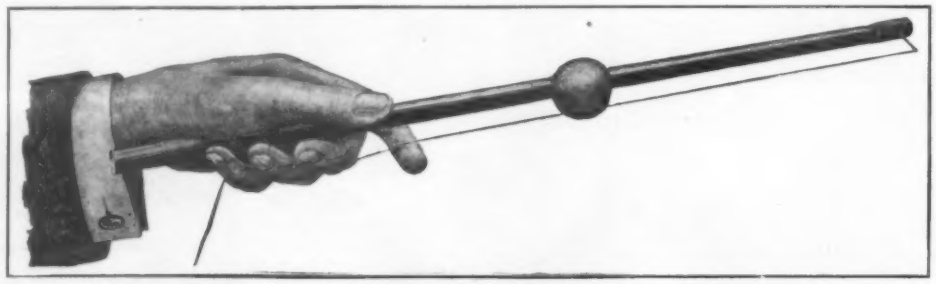
Another clever trick is also easily performed. Anyone attempting to balance a ball around a polished stick will realize the extreme difficulty of such a feat. Nevertheless, the performer having given to the spectator for a minute inspection the wand which he may be using in some other trick, also the ball, proceeds to carefully place the ball at the center of the wand, when it will remain stationary, then it will roll up and down the entire length of the wand, after which the wand and ball are again freely examined.



The Magic Jewel Case.

The trick consists in the use of an ordinary wand, such as magicians use, with metallic ferrules at each end, a duplicate ferrule fitting loosely over the one at the end. It is provided with a short thin steel arm projecting from its end at right angles. At the end of the arm is a small iron, to which a fine black thread is attached. The thread is several inches longer than the wand. The prepared ferrule the performer has palmed, and after examination of the wand it is secretly put on its end, the thread is pulled down into the left hand holding the other end, and twisted around the middle finger. The thread on being stretched forms a kind of a bow, and when the bow is placed on the wand the ball will run up and down with the greatest ease as the wand is lowered or raised. The illusion is perfect, even at a short distance, to the audience, the ball appearing as rolling on the top of the wand. The ferrule is again palmed at the conclusion of the trick, so that the wand may once more be given for inspection.

The "Magic Jewel Case" is an innocent-looking affair covered with plush, and might contain a diamond pendant. As soon as the button is pressed an explosion takes place, and the case opens with a loud bang. A detonator is given a catapult motion by a coiled wire spring and strikes a cap which is secured to the anvil. While the case is being closed, a detent wire passes across the ends of the coiled springs, securing the detonator from coming into action. As soon as the case is closed, the detonator bears against the cover of the case. We are indebted to Mr. Martinka for these tricks.



A Clever Balancing Act.

SOME INTERESTING TRICKS.

Official Meteorological Summary, New York, N. Y., June, 1907.

Atmospheric pressure: Highest, 30.23; lowest, 29.52; mean, 29.94. Temperature: Highest, 88; date, 25th; lowest, 45; date, 2d; mean of warmest day, 79; date, 22d; coolest day, 48; date, 2d; mean of maximum for the month, 73.6; mean of minimum, 58.7; absolute mean, 66.2; normal, 68.9; deficiency compared with mean of 37 years, —2.7. Warmest mean temperature of June, 72, in 1888, 1892, 1899, 1906. Coldest mean, 64, in 1881, and 1903. Absolute maximum and minimum of this month for 37 years, 97, and 45. Average daily deficiency since January 1, —1.9. Precipitation: 3.29; greatest in 24 hours, 1.01; date, 29th, and 30th; average of this month for 37 years, 3.25. Excess, +0.04. Accumulated deficiency since January 1, —0.54. Greatest precipitation, 7.70, in 1887; least, 0.86 in 1904. Wind: Prevailing direction, south; total movement, 6,922 miles; average hourly velocity, 9.6; maximum velocity, 48 miles per hour. Weather: Clear days, 10; partly cloudy, 13; cloudy, 7; on which 0.01 inch, or more, of precipitation occurred, 11. Thunderstorms, 5th, 26th.

A New Invention for the Theater.

American theaters have been equipped with so many conveniences, one would suppose every possible need of the theater-goer had been fully supplied. Still, another novelty will make its appearance with the opening of the coming theatrical season, a novelty which is nothing more or less than a very ingenious mirror for the use of women. The invention is known as the opera mirror, and has been patented by Mrs. Bessie M. Suter, of Louisville, Ky. It is so applied that by simply touching a leather fastening it can be placed at any angle, so that a woman may adjust her hat easily and conveniently after the performance. In addition the device provides a means for the disposal of hats and wraps, so that the necessity of spending much time in a cloak room is obviated. Mrs. Suter claims for her device ease of adjustment, simplicity of construction, strength, and durability. The invention was first brought to Mr. Daniel Frohman's attention by Mr. James W. Morrissey, managing director of the Joseph Jefferson Monument Association. Mr. Frohman will probably use it in his New York Lyceum Theater.

CAPTIVE BALLOONS IN THE GERMAN ARMY AND NAVY.

BY DR. ALFRED GRADENWITZ.

Because of the great difficulties frequently encountered in choosing a conspicuous point from which to inspect an enemy's position, captive balloons have been for many years adopted in the German Signal Service. The first type used in this direction was the familiar spherical balloon, which, however, is fit for use only if the atmospheric conditions are favorable. A cylindrical type of balloon was therefore first suggested in 1893 by A. Riedinger, of Augsburg. This balloon, being placed in an inclined position against the wind like a kite, was imparted an upward pull reinforced by the wind itself. But simple though this construction seemed to be, the desirable stability was not obtained before many difficulties had been overcome; in fact, a purely cylindrical balloon with hemispherical ends, so far from being stable, will perform spiral curves in the wind and quickly reach the ground. Lieut. von Parseval, however, developed the balloon to a satisfactory stage of reliability, so that the observers could work freely even in the case of heavy winds.

A schematic view of the improved type of balloon now being used in the German army is given in the

diagram, the principle underlying its construction being as follows: The cylindrical balloon is divided into two compartments, the upper large compartment being the gas chamber and the lower one the "ballonet," separated by horizontal partitions. This is provided with an opening directed against the wind so as automatically to fill with air at the same tension as produced by the arriving wind. This pressure is propagated through the upper ballonet wall into the gas chamber in which there is in addition the surplus pressure of the gas. There will thus be a greater pressure in the interior of the balloon than in the surrounding air. The issuing wind will consequently be unable to produce any hollows in the balloon as is the case with spherical balloons. In fact, spherical balloons which permanently keep their smooth and stable surface are subject to much less oscillation.

The rudder, constituted by a hollow ring applied to the lower rear portion of the balloon, serves to insure a sufficient stability. Like the ballonet, it automatically fills with air, any excess of air escaping from its top. While protecting the balloon against horizontal oscillations, the rudder will keep it in the direction of the wind. The stability is further increased by "wind catchers" which, arranged in the lee of the balloon, and exerting on the latter a constant pull, thereby check any lateral motion. The weight of these "wind catchers" is in turn compensated by planes both to the left and right in the rear part of the balloon alongside its equator, which planes insure additional stability.

A further safety device is afforded by the gas valve, opening automatically as soon as the balloon, having broken its rope, reaches an excessive height. The pressure of the outside air will decrease as the balloon rises to ever greater heights, and because of the tendency shown by the gas to expand, there will be a risk of explosion. This is obviated by connecting the valve with a string to the upper wall of the ballonet. As the expanding gas throws the ballonet wall downward, the string will be tightened, thus automatically opening the valve. It may be said that this device has done excellent service in many cases, when the rope had given way.

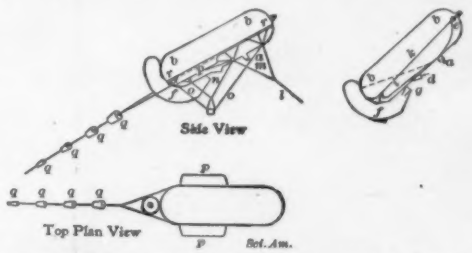
The adoption of these kite balloons has provided the signal corps of cavalry troops with a means of quickly realizing the situation at the front, substituting for the former chance operations a reliable, accurate, and well-organized service, which is independent even of heavy winds.

At the inauguration of the Milan Exhibition, the German aerostat detachment succeeded in filling and raising its balloon of 600 cubic meters capacity within 25 minutes. The balloon itself served as a motor, being lifted of its own accord by the upward pull of the gas.

The operation of hauling the balloon in, in case the resistance of the arriving wind has to be overcome, will be found far more difficult. For this purpose a roller is generally attached to the rope, and over this a number of ropes reach down, the knots of which are seized by the men, who while running with the wind against the balloon, cause it to sink by the pull exerted on the ropes.

The rope winch exhibited by A. Riedinger at the Milan exposition is provided with a 20-horse-power gasoline motor, which seems to be an advance over the French type of steam-driven winch; the low position of the drum will be found a decided advantage. The use of such rope winches will greatly increase the scope of military aeronautics, owing to the independence of bad weather which they afford.

Most interesting are the possibilities of kite balloons at sea, where because of heavy gales spherical balloons are quite out of the question. The atmosphere is generally clearer than inland, no dust being stirred up by the wind or any air currents heated by the sun. In fact, in the case of clear air, the area to be controlled will increase in proportion to the altitude of the point of observation. With the aid of sharp field glasses the various types of ships may be distinguished at distances of upward of 200 kilometers (124 miles). This obviously increases the range of a scout ship equipped with a balloon.



a, Charging valve; *b*, gas bag; *c*, ballonet; *d*, air valve to ballonet; *e*, valve; *f*, rudder; *g*, air valve to rudder; *h*, wind escape from rudder; *i*, upper wall of ballonet; *k*, internal valve chain; *l*, cable; *m*, bridle; *n*, car ropes; *o*, car-adjusting ropes; *p*, planes; *q*, tail composed of air receptacles; *r*, belt.

Captive balloons can be used to advantage in locating the positions of submarine boats. It is a well-known fact that we are able to look through clear water to a considerable depth; within certain limits the higher one is placed above the surface of the water, the greater will be the distance that one can see below the surface. The first attempt to utilize this fact in connection with the searching for sunken ships by means of captive balloons was made in Russia as far back as in 1894, when the warship "Russakka" was searched for in the Gulf of Finland. While this first attempt proved a failure, on account of the muddy water, experiments since made at Toulon by the French navy in the beautiful blue-green waters of the Mediterranean have been attended with favorable results.

Because of the ever-increasing use of submarine boats, which are able without being seen to destroy even the largest liners, the importance of this special use of captive balloons will be readily appreciated.

Interesting and most instructive experiments have been recently made in this connection in France on the submarine "Gustave Zédé," which having dived to a depth of 3 meters (10 feet) was allowed to take any submarine course its commander desired, at a normal speed. A captive balloon, which had been raised after its disappearance, was able after a few minutes to detect the submarine. It may be said that the search was facilitated by the wash of the submarine glittering in the sun's rays. Moreover, the green color of the submarine was found not to afford the expected protection against discovery.

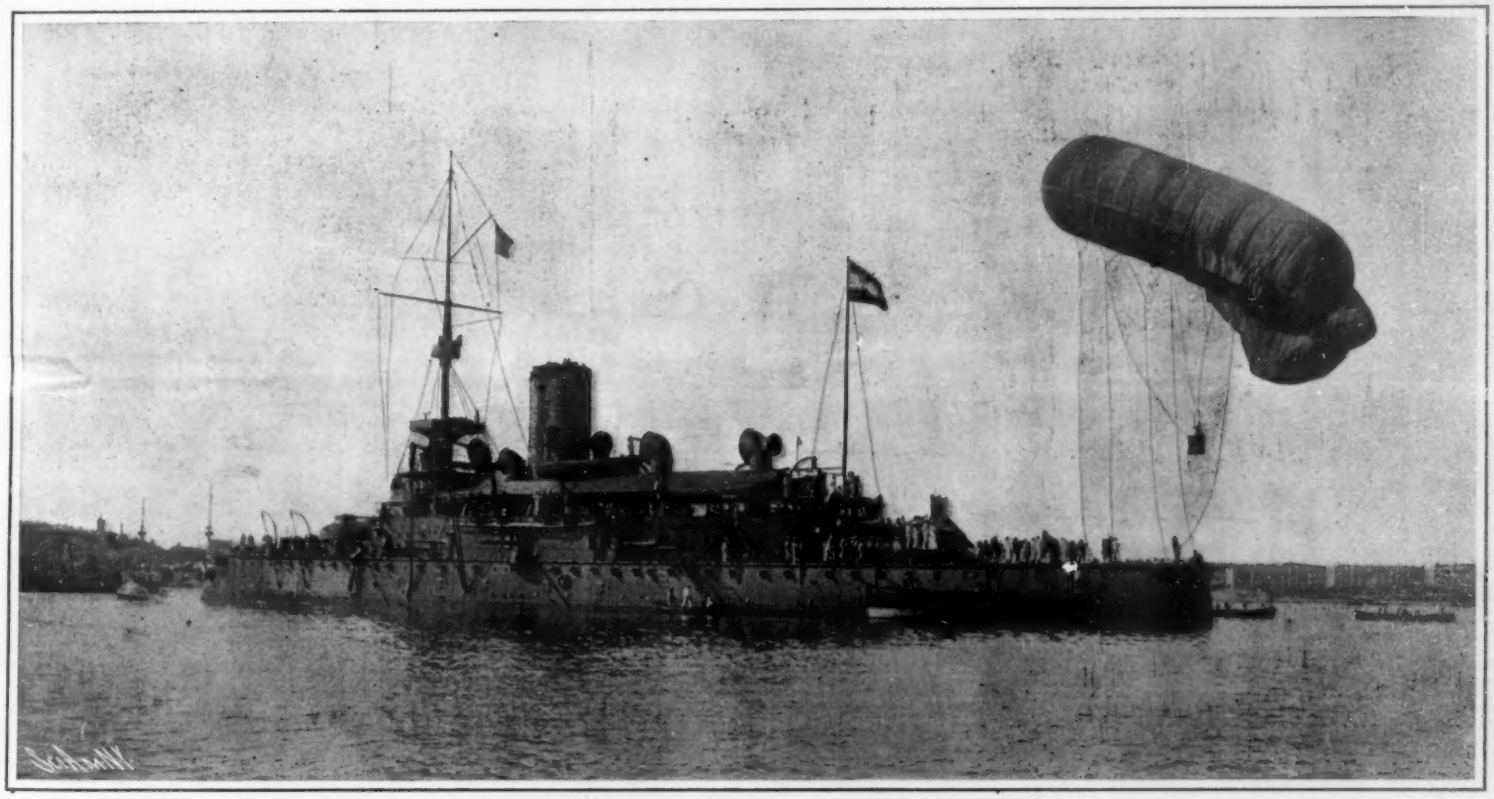
Moored or floating mines are obviously sighted most easily from a balloon. In fact, any objects to be watched are much larger and far more easily recognized than they are on land because there are no other objects with which they can be confused.

A most important desideratum for kite balloons to be used on the sea is that they should not interfere to any considerable extent with the motion of the vessel. As regards the speed of the ship, this will not be influenced to any appreciable degree by the balloon. Supposing the horizontal component in the cable to be 1,000 kilogrammes (2,205 pounds), conditions will be about as follows in a medium-sized vessel with 4,000 indicated horse-power:

In case the vessel sails 20 knots, that is, about 10 meters (32.8 feet) per second, the effective power of the screw being 2,000 horse-power, or 150,000 kilogramme-meters (484.35 foot-tons), the speed of sailing will be slackened by the pull of the balloon by 1/2 x 1/5 = about 3 per cent, which amount is practically inappreciable. In case the balloon is drifting along the course of the vessel, it will interfere still less with the sailing of the ship. The balloon should be moored to the vessel amidships.

As a balloon does not interfere with the speed of the vessel, it therefore should not reduce its range of operation. The gas should, if possible, be generated on board the ship, in generators producing hydrogen through the electrolysis of distilled water.

It may be mentioned that the German antarctic expedition which sailed on board the "Gauss" carried for the purposes of observation a spherical balloon of 380 cubic meters (13,417.8 cubic feet) capacity in addition to a store of 450 steel tanks containing each 36 liters (1.23 cubic foot) of gas under a pressure of 150 atmospheres. At the conclusion of the expedition the remaining steel tanks were inspected, when their gas pressure was found to be 147 to 150 atmospheres, thus showing that during the two years the tanks had been kept on board, no appreciable leakage had taken place, in spite of the considerable differences in temperature to which the tanks had been repeatedly exposed.



TESTING THE CAPABILITIES OF CAPTIVE BALLOONS WITH THE AUSTRIAN WARSHIP "RADETSKY."

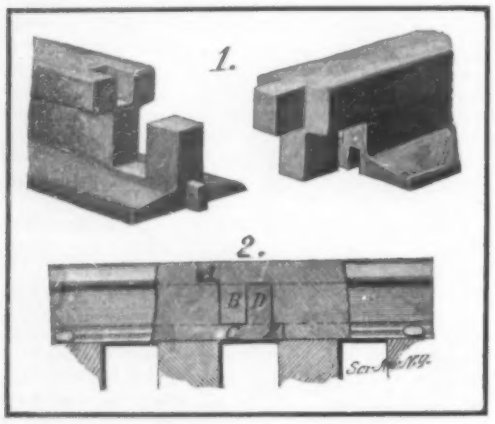
Reclaiming Alkali Lands.

Experiments have been conducted by the Department of Agriculture at Fresno, Cal., with a view to reclaiming alkali lands by drainage. Operations are now being conducted in a large vineyard near Fresno, where alkali has come rapidly to the surface. It is hoped that immense tracts which have long lain waste may thus be rendered fertile. There are many thousands of acres of these alkali plains in Fresno County, Cal., which are now useless, but it is believed that their drainage could be easily accomplished through the use of electric power for pumping purposes.

Patent Department

INTERLOCKING RAIL JOINT.

A recent invention provides a rail joint in which the meeting ends are firmly yet detachably connected without the use of fish plates and bolts, or other form of fastening independent of the rails themselves. The method of accomplishing this novel result is clearly illustrated in the accompanying engraving. Fig. 1 shows two meeting ends of a rail, while Fig. 2 is a section through the rails at the joint. It will be noticed that the base of the rail at the right-hand side is cut away, leaving an overhanging head. The head is formed with a projecting portion *A*. Part of the web is retained to form a vertical post *B*. A slot is cut in the base of the rail. The left-hand rail is formed to interlock with the right-hand rail. The head is cut away, and a slot is formed therein to receive the projection *A*. Part of the web is cut away to receive the post *B*, while the post *D*, left standing, fits into the recess formed behind the post *B*. A lug or projection *E* fits into the slot in the base of the right-hand rail. It will now be seen that if the right-hand rail be raised, and its projecting portion brought over the projecting base portion of the other rail, and then lowered vertically, the rails will be engaged or interlocked. The tenons *A* and *E* will prevent lateral movement of the rails, while the posts or abutments *B* and *D* will prevent endwise movement of the rails. In use the weight applied by the wheels of a passing train will be imposed directly upon the overhanging portion of the right-hand rail, and thereby upon the underlying portions of the left-hand rail. The inventor proposes to construct these joints by means of stamping dies. A patent on this novel rail joint has been granted to Mr. John C. Abbott, of Carnegie, R. D. No. 1, Penn.



INTERLOCKING RAIL JOINT.

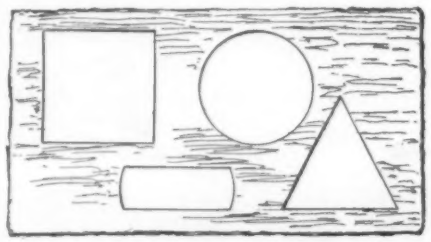
APPARATUS FOR SUSTAINING AND DIRECTING BALLOONS

An apparatus of considerable novelty has recently been devised by Mr. Ignace Gruber, of 407 East 138th Street, New York city, which has for its object the control of a balloon or airship. The control is effected by means of a jet of air, which may be directed wherever needed. If, for instance, the balloon is descending, owing to leakage of gas, or to sudden cooling of the gas in passing over a body of water, the air jet is directed downward, when by pressure on the atmosphere outside, and also by reaction of the jet, it will tend to sustain the balloon. Similarly, if the balloon is rising too rapidly, the air jet may be directed upward to resist this motion. Thus sand ballast may be dispensed with. The compressed air is supplied by a centrifugal pump driven by a small motor in the basket or the car. As shown in our illustration, a pair of pulleys *A* are mounted on blocks *B*, at opposite sides of the balloon, the blocks being kept in position by a strap which runs over the top of the balloon, and a pair of stays or ropes which run down to the basket. Mounted on these pulleys is a nozzle, which is connected by a flexible pipe *C* with the air pump in the basket. A cable *D* is passed over each pulley *A*, and has its lower ends attached to the opposite ends of a lever. The levers on opposite sides of the basket are keyed to a shaft, which is provided with a handle *E* at the center. By turning the handle in one or the other direction, the pulleys will be turned, swinging the nozzles of the air pipes *C* in the desired direction. One of the objections to the present system of using sand ballast is that when the ballast is thrown overboard to lighten the balloon, it cannot again be regained. In the present system of using a pneumatic jet there is no such loss of ballast; for an inexhaustible supply of ballast is found in the medium which surrounds the balloon.

APPARATUS FOR SUSTAINING AND DIRECTING BALLOONS.

THE PLUG PUZZLE.

The following puzzle was brought to our attention by Mr. P. S. Hay, of Montgomery, Ala. We recognize in it a problem which occasionally appears in civil service examinations to test the ingenuity of the applicant. Take a board and cut four holes in it of the



CUT A PLUG THAT WILL FIT ANY ONE OF THE HOLES.

relative size and shape indicated in the drawing. Then cut a single plug to such form that it will snugly fit any one of the four holes. The solution of this puzzle will be published in a subsequent issue.

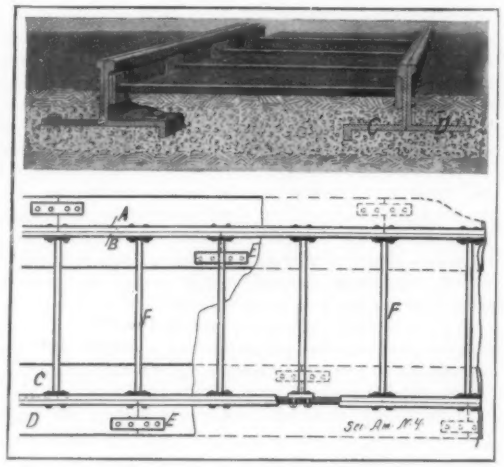
A Giant Oil Conduit Planned.

The Southern Pacific is soon to spend $2,000,000 on an immense oil pipe-line from the Kern County oil fields to a point on San Francisco Bay opposite the city. It will be 265 miles long, and will consist of an 8-inch pipe for the entire distance. This will be the first railroad company in the world to own and operate its own pipe-line. It is intended to supply the Southern Pacific's hundreds of locomotives in California at a minimum cost. The company find it impossible to buy or build enough tank cars to distribute oil at two hundred or three hundred points in the State to daily supply all its engines.

On the 265-mile route there will be 23 pumping plants, each with two single or triple compound duplex oil pumps of special design; also two water pumps for injecting water to facilitate the flow of the oil through the pipe-line from the wells to San Francisco Bay. At each pumping plant there will be a 750-horse-power battery of water-tube boilers in three units; also two large steel tank reservoirs for storage purposes. Work is expected soon to be commenced on this immense project.

RAILWAY TRACK CONSTRUCTION.

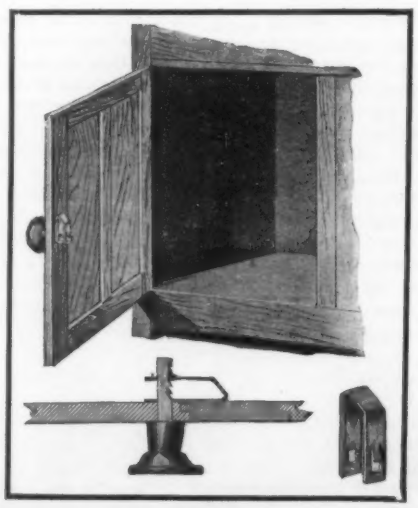
Illustrated in the accompanying engraving is a new form of track construction which does away with the use of ties, and in which that side of the rail that is worn may be taken up and replaced without interfering with the opposite side of the rail. The rails are longitudinally divided on a central vertical plane. The two sections of each rail are bolted together. The abutting ends of alining sections break joints with those forming the opposite side of the rail. Each rail is constructed with an extended base flange, which is imbedded in a roadbed of concrete. To assist in maintaining the rails at proper gage, transversely arranged tie bars are used. In the illustration the two sections forming each rail are respectively indicated at *A* and *B*. The base of the section *A* is formed with a broad flange *D*. The base flange *C*, on the section *B*, differs from the flange *D* in having a downwardly-turned outer edge. This when imbedded in the concrete roadbed serves to hold the rails against spreading. The construction is made doubly secure by the use of tie bars *F*. Not only do the sections *A* break joints with sections *B*, but the rails on one side of the track break joints with those on the opposite side, and the tie bars are arranged to connect each joint to the solid portion of the opposite rail. Abutting ends of the rail sections are connected by means of the usual fish plates. The flanges are also connected by means of plates *E*. Since the inner sections *B* will wear out sooner than the sections *A*, the former may be replaced without removing the latter, thus reducing the cost of maintenance. The inventor of this novel railroad track construction is Mr. John H. F. Shulze, 63 Union Hall Street, Jamaica, N. Y.



RAILROAD TRACK CONSTRUCTION.

AN IMPROVED BUTTON LATCH.

A very useful improvement in latches of the button type, used in fastening cupboard and closet doors, has just been invented by Mr. F. W. Merriweather, of 1404 Grand Avenue, Kansas City, Mo. The object of the invention is to provide a simple construction, which will hold the door tightly closed and prevent any shake or looseness between the door and latch when the latter is applied. The invention also provides for the convenient adjustment of the tension on the button, whereby the stiffness of the latch may be varied. It is a very common defect of the usual wooden buttons to work loose, and swing clear of the door of their own gravity. This defect is overcome by Mr. Merriweather's invention. The illustration clearly shows how this is accomplished. A knob or handle, of any desired form, is rigidly attached to a shank, which passes through an opening in the door. The projecting inner end of the shank is angular in cross section, and is provided with ratchet teeth cut in one of its edges. The button of the latch is constructed of a strip of spring sheet metal, bent upon itself to provide a pair of spring arms, which are spaced apart and have alining openings adapted to slidably engage with the shank. A tongue cut from the upper arm is bent upwardly, to engage with the ratchet teeth when the button is applied to the shank. It is obvious from this construction that on forcing the spring arms together, the force with which the knob and button are pressed against opposite faces of the door may be varied as desired, thus enabling the stiffness of the latch to be increased or decreased at pleasure.



AN IMPROVED BUTTON LATCH.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

MEDICAL BATTERY.—C. W. TAYLOR, New York, N. Y. The invention relates to medical and surgical electricity. The object is to provide a battery exceedingly compact, and arranged for hand use, to enable a person to conveniently apply the apparatus to any part of the body, to cause a current of electricity to pass, by way of the hand holding the apparatus, to the body-part on which the device is applied at the time.

CIRCUIT-CONTROLLER.—E. S. MASSIE and J. H. HAWKINS, Quincy, Ill. In this instance the invention is in nature a circuit closing timer, or controller, employed in the sparker circuit of explosive engines. The object had in view is to provide means adapted for general circuit closing uses, but specially intended for use in sparker circuits.

Of Interest to Farmers.

PLANTING-MACHINE.—B. C. MCCOY, Pontiac, Mich. There is provision in this invention for planting seed-potatoes, corn, beans, or the like, an object being to furnish a practically automatic machine, by means of which two rows may be planted at a time, with the hills or planting at uniform distances apart, and in which the seeds are—before planting—at all times in view of the person on the planter, so that should a pocket not contain sufficient seed, more may be manually placed therein.

Of General Interest.

METHOD OF INKING PRINTING-FILMS.—B. DAY, West Hoboken, N. J. Mr. Day's invention consists of a novel method of converting a transparent sheet of any suitable material into a surface-printing and a medium, and then using this medium to print the inked design carried by it upon a surface to be subsequently printed from, as in the lithographic or other surface printing arts; or to print an inked design, or inked print, on metals such as zinc, copper, or brass, which are to be subsequently etched into the form of relief plates.

FILE FOR PAPERS.—E. STEBBINGS, Spencer, Iowa. The object of the inventor is to provide a file arranged to hold a large number of papers, to permit of conveniently placing the papers in position on the file-loop or removing any one of the papers from the loop without distributing the others, and to allow ready detaching of the loop and its contents from its support or replacing the same whenever it is desired to do so.

WINDOW-SHELF.—R. B. SMART, Chicago, Ill. This window support is more especially designed as an attachment for windows for supporting milk bottles, flower pots, boxes containing flowers and like articles, and it is arranged to permit convenient attachment to the window and allows placing the articles in position on the platform of the support or removing the articles therefrom.

BUCKLE.—G. E. RAWSON, Louisville, Ky. The object of the invention is to make a buckle strong and simple in construction, effective in operation and durable in use, and adapted to be used for all general purposes, for which any buckle can be used, and especially adapted to be used on belts, saddle girts, trunk and skate straps, and in other connections requiring a tight fastener.

BAND-SAW GUIDE.—J. J. CALLAHAN, St. Johns, Newfoundland. It is sought in the present invention to provide a guide for a band saw which is as free from friction as it is possible, and in which the band saw is held in its proper position and which is inexpensive to make and easy to adjust. It relates to guides used in wood working and other analogous arts.

DEVICE FOR FASTENING HEADS TO BUSTS.—E. T. PALMENBERG, New York, N. Y. This improvement has reference to display forms and its object is to provide a new device for conveniently, quickly and securely fastening the head of the bust of a display form without danger of disfiguring the external appearance of the head or bust.

MUSIC-LEAF TURNER.—J. O'CONNOR, New York, N. Y. The device is designed to be attached to a piano or similar instrument, or to a music rack, and is adapted to be operated by foot pressure, thus leaving the hands of the player free at all times to operate the instrument, the parts being so arranged that the leaves may be quickly turned one at a time as the music progresses, or simultaneously turned back to a closed position.

DISTILLING APPARATUS.—M. LLODRA, Manila, Philippine Islands. In this patent the improvement is in a distilling apparatus. The wash as it passes through the refrigerating column and the condensing cylinder, will condense the vapor from the distilling column, and the vapor will give up its heat to the incoming wash, thus gradually heating the same during its passage toward the caldron.

TRAY FOR STEAMING YARN.—W. E. LYFORD, Thompsonville, Conn. The aim of this inventor is to provide a tray for supporting printed yarn during the process of steaming the same, with a view to fix the color, the tray being arranged to allow the steam to readily penetrate all portions of the yarn in a comparatively short time and to allow compact nesting of a plurality of trays for steaming a large amount of yarn in a small space.

MANUFACTURE OF BLOCKS.—I. LUCAS, Passaic, N. J. This invention pertains to the manufacture of cement blocks, artificial stone blocks and the like, and its object is to provide certain improvements in the manufacture of blocks made from plastic material, whereby the blocks are rendered highly homogeneous and exceedingly strong and durable.

FLUSHING DEVICE FOR WATER-CLOSET BOWLS AND THE LIKE.—L. W. EGGLESTON, Appleton, Wis. The usual tank and supply tank are employed by the inventor. At the upper end of the pipe is a valve casing in which is a nozzle or injector discharging water into the tank. A plug valve having slidable movement within the casing and movably connected with which is an actuating lever, through whose medium the valve is caused to open the nozzle outlet and again close it. A controlling member is employed for the lever intermediate of which and a co-operating float are other members of special construction. The flushing devices are primarily actuated by the usual pull-chain.

BLADE-HOLDER FOR RAZOR-BLADES.—T. F. CURLEY, New York, N. Y. The object in this improvement is to provide a holder for razor blades used in ordinary and safety razors, and to be held in stropping and honing machines and other devices, the blade holder being arranged to hold a blade securely in position during the use of the razor, machine, or other device, and to allow an interchange of blades of different thicknesses.

MOLD FOR ARTIFICIAL STONE. — F. NELSON, Menoken, N. D. The invention has reference to improvements in molds for forming building blocks of concrete, the object being the provision of a mold by means of which the blocks may be readily shaped and so formed that a completed wall will have a continuous air passage or space from top to bottom.

VESSEL.—J. MCARDLE, San Francisco, Cal. The principal objects of the inventor are to provide a structure which shall be safe, readily controlled, and efficient, the speed developed being high as compared with the power applied. Propelling floats hold the hull clear of the water, entirely eliminating the pushing and dragging movement present when a hull is forced against the water by a small stern propeller.

STORAGE AND COOLING VAT FOR MILK OR CREAM.—Z. S. LAWRENCE, West Shefford, Quebec, Canada. The vat which forms the object of this improvement, is preferably of large capacity and of such construction that the milk or cream contained therein may be subjected to a slow or gradual cooling or be suddenly chilled, as desired; also providing for a thorough mixing of the contents, bringing the same to a uniform consistency before drawing it off.

OIL-CAN.—A. F. DEMORY, Houston, Texas. The aim of the inventor is to provide a non-explosive can from which oil can be readily poured, and which will be air-vented and the pouring and filling means will render the can non-explosive by preventing the passage of flame to the interior of the can through either the filling or dispensing means.

WATER-COLOR BRUSH.—J. W. HAWKINS, Passaic, N. J. The intention in this case is to provide an improved water color brush more especially designed for use in making wash drawings, and arranged to enable the user to readily apply the color with one brush and give the desired gradations of tone with a second brush.

NON-REFILLABLE BOTTLE.—G. FRASER, Jersey City, N. J. A valve is provided which is automatic in action and so located in the stopper that it will be in constant communication with the body of the vessel, but cannot be reached or tampered with from without, which valve acts to effectively cut off the supply of air to the vessel while the latter is in an upright position, but wherein as soon as the vessel is tilted air will be admitted in more or less quantities ample to permit the ready flow of liquid from the vessel.

FOOD PRODUCT AND PROCESS OF MAKING THE SAME.—F. H. L. CLARKE, Villa Bellerive, Cannes, France. The object of the invention is to supply an alimentary product which, besides having a high nutritive value, shall be cooling and very readily digestible, so as to be specially adapted for use as a diatetic in cases of dyspepsia. The ingredients afford all the essential elements of a complete food in a concentrated form, viz.: albuminous matters or proteids, fatty substances, and carbohydrates.

TRUNK-ROPE FASTENER.—E. W. CARROLL and F. S. BAIRD, Congress, Ariz. Ter. The device is adapted to be attached to trunks, boxes, chests, and the like, for tightening and holding the ends of a rope or cord used to firmly hold the trunk, box, etc., in its closed position. The object is to provide means easily applied to any container whenever desired, and which completely conceals and protects the ends of the rope, whereby the latter can not readily become disengaged.

CHAIN.—H. T. CURRIE, Chicago, Ill. The chain comprises interlocked links, each provided at the inner face of each end with a recess and an anti-friction metal filling the said recess, and conforming at its outer surface to the contour of the inner face of the end of the link. The chain is arranged to reduce the friction of the links to a minimum.

CURRYCOMB.—R. F. LAWSON, Effingham, Ill. Well rounded teeth arranged in alternate rows enable the operator to cover every part of the animal's hide without pain or injury to the tender skin in such manner as to thoroughly cleanse the animal of all dirt, dust, dandruff, dead hair, etc., with great facility. The comb should be moved sidewise over the parts and when drawn lengthwise through the mane and tail will most effectively comb the long hair.

Hardware.

FILE.—H. GETAZ, Schenectady, N. Y. The improvement refers to that class of files in which the teeth are composed of a series of cutting blades clamped together in an angular relation and adapted to be readily sharpened when dull. The object is to improve the files, especially in the matter of providing for the deflection of the blades in an effective manner.

NUT-LOCK.—R. D. BAKER, Las Vegas, Nevada. In the operation of this nut-lock, the nut is turned upon the bolt the required distance. The end of a lock is then inserted in the longitudinal groove of the bolt, until the shoulder at the end of the cut away portion is in engagement with the outer face of nut, at which point the transverse end of the lock will be in engagement with one of the grooves of the nut.

Heating and Lighting.

HEATING-STOVE.—W. HEUERMANN, Sedalia, Mo. There is provision in this stove for a relatively large heating surface, a long flue or passage for transverse of the heated gaseous products of combustion. The stove occupies a relatively small space. It comprises a combustion chamber and a superposed heating chamber connected and supported together from the top of the downwardly extended flues or pipes, the latter serving practically in the place of legs or other usual form of support.

EXPANSION-TUBE.—O. S. PEDERSEN, New York, N. Y. The aim of this invention is to produce a heating tube having a form enabling the same to take up the expansion or contraction of the tubes longitudinally, tending to make the joints leaky and otherwise defective, without affecting the joints at the ends of the tube. It relates to heating tubes, such as used in boilers and feed water heaters.

DOMESTIC AND INDUSTRIAL HEATING APPLIANCE.—C. J. ROUX, 85 Route d'Aubervilliers, Pantin (Seine), France. Complete combustion of fuel is effected by this invention and all heat furnished by the products of combustion is absorbed. The general arrangement of the apparatus permits of raising the reignition chamber to and maintaining it at a very high temperature, producing the reignition of the dead combustible products still contained in the products of combustion.

APPARATUS FOR CONSUMING SMOKE IN STOVES AND FURNACES.—C. J. ROUX, 12 Rue Doudeauville, Paris, France. The invention has reference to apparatus for consuming smoke in stoves and furnaces and is applicable to domestic and industrial heating apparatus of all kinds. By its means complete combustion may be obtained and absolute consumption of smoke, whatever the nature of the fuel may be, as soon as normal conditions have been established, even with the softest coals.

Household Utilities.

SKIMMER.—J. F. IRBY, Baltimore, Md. The skimmer is provided with a dished bottom, and at the upper portion of the bottom with an opening through which grease and other surface portion of soup may pass to flow into the bottom and be retained by the rim of the skimmer in the use of the device. In connection with the dished bottom the inventor prefers to provide a bell-shape flange at the base of the rim, and extending outwardly to increase the surface acted upon by the skimmer.

Machines and Mechanical Devices.

POWER-TRANSMISSION MECHANISM.—F. SEDIVY, Globe, Ariz. Ter. The invention relates to a former patent granted to Mr. Sedivy. The present has among objects to provide means whereby the stroke of the machine may be varied. An important feature is the provision for adjusting the position of springs so the stroke of the traveler may be varied by reversing the rockers at different points, and he prefers to make the means for supporting the opposite sets of springs independent so they may be independently shifted to enable reversing of the detent devices at any position.

MECHANICAL MOVEMENT.—A. LINDSAY and J. MEINERT, Davenport, Iowa. The improvement relates more particularly to that class of gearing designed to convert the rotary motion of the power shaft into alternating motion in the driven shaft. The principal object is to provide a gearing in which the reversal of the direction of the driven shaft is accomplished quickly and with the minimum amount of friction, the mechanism being easily operated. The gearing is particularly designed for washing machines.

PICKER-STICK CHECK. — N. VAILLANCOURT, Lewiston, Maine. In this instance the invention refers to looms, and its object is to provide a check arranged to insure an easy impact of the shuttle on the picker stick, thus preventing breaking of the filling, and to reduce the liability of the breaking of the picker stick and picker straps to a minimum.

WORK-GAGE.—F. M. CHAPMAN, R. W. CHAPMAN and H. W. CHAPMAN, Oldtown, Maine. The invention relates to a work gage intended especially for use in connection with wood working machines, particularly with circular saws, the gage being mounted on the saw table and adjustable toward and from the line of the saw so as to gage the width of the material sawn.

EXERCISING APPARATUS.—J. J. COOPER, New York, N. Y. The object of this inventor is to provide an apparatus arranged to produce an exceedingly healthy action of the various members of the human body, notably the muscles, intestines, and other vital organs, with a view to invigorate the body and to cure constipation, to reduce obesity, etc.

PASTING-MACHINE.—J. H. TRISMEN, New York, N. Y. The machine is more especially designed for pasting sheets of tissue paper or other material together to form ornaments, such as bells, festoons, lamp shades, and like articles, the arrangements being such that a large number of sheets can be quickly and accurately fastened together without skilled labor.

CORN-POPPER.—G. B. YOUNG and J. H. YOUNG, El Paso, Texas. This corn-popper device may also be used in roasting peanuts and chestnuts and as a cooker generally. Primarily the inventor's object is to provide for the cooking, roasting, etc., preferably by electrical means in a manner that the same may be carried out uniformly and also provide for the automatic release of the corn from the popper should the pan fill to overflowing. The Messrs. Young have also patented a corn-popper in which the subject matter of the present application is directed to improvements in corn-poppers divided from their copending application formerly filed. It is also not limited to the particular use of popping corn, as it may be employed in roasting peanuts, chestnuts, and as a cooking device generally.

STICK-FEEDER.—W. H. WALDRON, New Brunswick, N. J. The invention pertains to drying machines, such as used in the manufacture of wall paper and the like, and its purpose is to provide a feeder arranged for properly spacing the sticks used as supports in hanging up the freshly coated or printed paper for drying or other purposes.

CARTON-FILLING MACHINE.—R. SUNDERMAN, Buffalo, N. Y. The invention comprises mechanism for moving a carton into position to be filled, means for forcing into the carton, while in stationary position, the material to be filled into the carton, and mechanism for removing the carton after the filling thereof. While the present invention may be used in carton making machines of various kinds, Mr. Sunderman preferably employs it in a machine such as described in his pending application formerly filed.

COAL-MINING DRILL-POST.—P. ROMMES, Pittsburg, Kan. One of the objects in this instance is to provide means for determining the course the drill takes before the post is firmly set and to save work and time; another is to prevent the post from giving way when set on soft or infirm bottom; another is to secure firmness and obviate wabbling motion; another is to afford facilities for adjustment of threaded box; another to facilitate changing drills and removing borings from drill hole; and lastly, to afford means for attaching threaded boxings of various types and makes.

LOADING APPARATUS.—E. ROSENVALL, Salt Lake City, Utah. The coal or grain to be loaded passes down a chute upon the circular table, which is rotated by a shaft. Rotation of the table or hopper throws the grain from the side thereof, into different parts of the car, and by adjusting the inclination of the table to the carriage, and the position of the shield, the grain may be thrown up or down as desired. Any suitable mechanism may traverse the carriage upon the track.

FIRE-ESCAPE.—G. J. PITTS, New York, N. Y. The invention refers to improvements in the portable type, or that class placed in a room near a window, so as to be in position for instant use, the object being to provide a device automatic in its braking or retarding means, when used under a certain condition, and under control of a person when under another condition.

SAW-SWAGE.—J. HANCHETT, Sheridan, Mich. The invention comprises in a saw swage, in combination a block having a channel in the under face adapted to receive the edge of the saw blade, an anvil mounted in the block, a swaging device attached to the block and co-operating with the anvil, a lever actuating the device, a brace rotatably mounted in the block having an arm engaging between the teeth of the blade and having a second projecting into the lever's path and constituting a stop therefor.

MACHINE FOR VARNISHING EYELETS.—I. W. GILES, New Bedford, and C. W. TOBEY, Fairhaven, Mass. These inventors have found that a flat brush arranged to revolve in a plane parallel to the face of the eyelets is entirely effective in distributing varnish with uniformity. They employ two flat annular brushes arranged to revolve in opposite directions. Whereby the distribution is distributed more evenly than by a single brush.

ROCK-DRILL.—J. B. Marshall, Broken Hill, New South Wales, Australia. According to this invention the recess is made in two portions and its depth varied to give smaller escape for the air at the forward end of the piston, thus the front end of recess passing the front relief port permits not sufficient escape to cause sudden reversal of valve nor does reversal occur until a deeper part of the recess encounters the relief port. There is adequate escape at all parts of the stroke for reversing.

Prime Movers and Their Accessories.

TRACTION-ENGINE. — A. S. Wysong, Meade, Kan. The invention lies largely in the detail construction and arrangement of the transmission gear and in the frame and the bearing boxes for the shafts. Frame portions are secured adjustably in the main frame and the bearing boxes of the adjustment devices, all with the view to facilitate the adjustment of the tension of the sprocket chains.

Railways and Their Accessories.

VENTILATOR FOR CARS.—H. Van Ness, New York, N. Y. When the ventilator is properly set to the roof of a car and particularly when the car is in motion, a current of air will enter the ventilating chamber at one end and pass over the ventilators, creating a suction to draw all foul air upward and conduct it to an exit at the opposite end of the car, thus providing a perfect ventilation without drafts.

TRACK-SPREADING SIGNAL.—I. M. Bond, Tacoma, Va. The object of the invention is to automatically indicate the spreading of the rails of railways at any particular point at which the device is applied. It frequently happens that one of the rails of railways under constant usage, especially on sharp curves, is loosened and sprung outward, and if unnoticed and neglected causes derailment at this point. Mr. Bond's novel device secures the avoidance of this trouble.

SMOKE AND CINDER CONDUCTOR.—H. L. Labbey, Charleston, S. C. The aim of the inventor is to provide a conductor, arranged to conduct the smoke and cinders from the smoke box of the locomotive back over the locomotive tender and cars, to increase the draft and to prevent back draft in the fire box when the doors thereof are opened, to insure a free exhaust and thus relieve the locomotive engine of back pressure.

Pertaining to Recreation.

ADJUSTABLE SWING.—C. F. Bean, Fort Tampa City, Fla. In this swing the character and degree of the tilting motion may be varied at will. The invention admits of general use, but is of peculiar value in reference to swings used for recreation and comfort, and in which an oscillatory motion is accompanied by a tilting motion.

GAME DEVICE.—F. W. Mosbley, St. Hyacinthe, Quebec, Canada. The aim is to provide a puzzle of that type which is manipulated by the hands of the operator to bring rolling objects to predetermined positions, wherein magnets are employed at the various stations for the rolling objects, and to provide rolling objects attractable by the said magnets.

TOY.—W. F. Schoenhut, Philadelphia, Pa. The aim in this instance is to provide a toy in the form of human or animal figures having movable body parts, to allow a child to conveniently and readily change the position of the body parts relative to each other, with a view to give different appearances to the figures to suit the mood of the child.

PUZZLE.—R. W. Kemp, Jr., New York, N. Y. In the present patent the invention relates to puzzles, the more particular object being to produce a device provided with rolling bodies and so arranged as to enable the operator, by a little skill, to place the rolling bodies in various predetermined positions.

Pertaining to Vehicles.

AUTOMOBILE DRIVING-GEAR. — R. S. McIntyre, Riverside, Cal. The invention pertains particularly, though not necessarily, to a means for driving motor vehicles, in which a countershaft is employed with the engine or motor by certain means for driving the shaft and for changing the direction of revolution, and connected with the rear or other traction wheels of the vehicle by means of chains running over sprockets, connected with the traction wheels.

FRAME FOR AUTOMOBILES.—E. Sanchis, 60 Rue Pierre Charron, Paris, France. The object of the invention is a system of motor car with three or four wheels characterized by the special construction of its frame and its method of suspension. These arrangements permit of doing away with the ordinary construction of car-body while giving the driver's seat the form of seats used for large carriages, of suspending it comfortably and bringing to the driver the mechanism of the control and steering gears, which can be arranged in the same manner as in a large vehicle and without diminishing the simplicity of construction of the tri-car, while giving it definite solidity.

HARNESS.—W. H. Sneed, Pensacola, Fla. The purpose of the inventor is to provide shaft-supporting collars, or shaft holders for vehicles, adapted for attachment to the saddle straps, so constructed that in harnessing a horse to a buggy it is simply necessary to raise a shaft and snap the holder thereon, thereby greatly facilitating the work, since necessity of backing the animal to a predetermined position between the shafts is not necessary.

NUT-LOCK.—D. B. Hanlon, New Liberty, Ky. The invention relates particularly to improvements in locking devices for nuts on vehicle axle skeins, an object being to provide a nut lock that may be readily and quickly adjusted for locking the nut in position and as readily detached when it is desired to remove a wheel from an axle.

MOTOR-VEHICLE STEERING-GEAR.—W. E. Slater, San Francisco, Cal. In its preferred embodiment the steering road wheels of the vehicle are connected with the motor cylinder; the admission or exhaust of fluid pressure to and from the same being under the control of a multiple valve placed convenient to the driver, and the fluid pressure being stored in the reservoir which in turn is charged by a pump coupled with the engine of the vehicle or with some other suitable driving element.

COLLAPSIBLE BABY-CARRIAGE.—G. A. Svanberg, Fort Lee, N. J. The principal object of the inventor is to provide a carriage or cart propelled by hand, of which the parts are few and arranged to be conveniently packed and folded so as to occupy but a small compass and which will then be in condition to be conveniently, quickly, and easily readjusted in operative positions and securely held in place for use.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10587) W. B. M. says: Will you kindly answer the following inquiry? Is the weight of water in a boiler "under steam pressure," additional pressure on bottom of boiler? Is the result the same when the water is above boiling heat, and when it is not? What makes a good belt dressing? A. The weight of water in a boiler under steam pressure *is* additional pressure on the bottom of the boiler, and the result is just the same when the water is above the boiling heat. Heating water does not change its weight. One-half neatsfoot and one-half castor oil makes a good belt dressing.

(10588) C. S. says: I have a blower making 100 revolutions per minute; discharge pipe is 24 inches in diameter; the blower is used for a pneumatic cash system of 75 stations. Now I would like to know if I can discharge the exhaust air from the blower into my smokestack without interfering with the draft of my furnaces. I have in use two boilers, 125 horse-power each; the stack is square, 3 feet x 4 feet 6 inches, and also has an offset a little above the center of the stack. The only place where I could exhaust into the stack now is about five feet *below* the boiler flue, that would be at the bottom of the stack. If I can't exhaust in this place, I would have to carry a line of pipe up on the outside of the building to a point above the boiler flue. Which would be the best? And would I need an elbow in the stack, so the air shoots up, or is it unnecessary? A. You do not give the height of your stack, nor the velocity, pressure, and volume of the air from the Root blower, so that it is impossible for us to make any exact calculation; but unless you have a draft very considerably in excess of what you actually require when forcing your boilers, it would not be wise for you to discharge the blower into the stack, because that would have the effect of materially reducing the size of your chimney. On account of the distance of the stack from the boilers, it is more doubtful if you have the draft to spare. In case you try the experiment, insert the discharge pipe from the blower at the base of the stack, with an elbow pointing upward.

(10589) C. J. S. says: How long is the scaling ladder in use in the New York Fire Department, and where was it invented, and how long is it in use in Berlin? Which is more improved—New York or Berlin? A. The scaling ladders used in the New York Fire Department were first used in 1883, and they run from 12 to 20 feet—12, 14, 16, 18, 20. At about the first time they were used, a very successful rescue was made by Chief of Battalion Binns. We have no information relative to the scaling ladders in use in Berlin, except that they are used. In general, we may say American-built fire engines are the best made, and we have never heard it questioned that the secondary part of the fire equipment was any less good. Owing to the methods of construction employed abroad they have fewer fires, therefore there is no such demand for improvements in fire apparatus as here.

(10590) O. N. writes us: Is a 16 candle power bulb frosted more luminous than one that is not frosted? That is to say, will one 16-candle-power frosted bulb give more light than one that is not frosted? A. An incandescent electric lamp with clear glass bulb will emit more light than one with a frosted bulb. The bulb cuts off light. No arrangement of the bulb can increase the light of the filament. It is the filament which gives the light, and not the bulb. Even a bulb of clear glass absorbs some light. One of partly opaque glass will, of course, absorb more light.

(10591) N. A. N. says: Will you please decide if there is a difference between a mile square and a square mile? I hold that a mile square is a mile around it, and a square mile is four miles around it. A. A "mile square" and a "square mile" have each the same area, but the phrases have very different meanings. A mile square is a figure one mile on each side, and all its corners right angles. A square field one mile on a side is a mile square. A square mile contains 640 acres, and may be in any shape whatever, circular, rectangular, etc., or of any irregular form.

(10592) F. A. F. asks: Kindly answer the following mathematical problem to set your readers right: We have an aquarium, a globe, 6¼ inches in diameter, 6½ inches high; the question is, How many pellets or buckshot ¼ inch in diameter will this globe or aquarium hold? A. The problem you send us may admit of a mathematical solution, but so far as we know it only admits of solution by experiment. Fill the globe with shot and count them. The globe is apparently an irregular solid. You give the dimensions as 6¼ x 6½ inches. This is not a spherical solid, and its shape is not determined by two dimensions only. The rate of curvature of its parts is not given by knowing two dimensions only. If it be assumed that the dimensions are the axes of an ellipse, then the solid is an ellipsoid of revolution and its form is definitely known. But it can hardly be assumed that a globe of glass blown by ordinary processes of the shop is an ellipsoid of sufficient accuracy to base a mathematical calculation upon. If its solid contents simply are known, the number of spheres which it would contain could not even then be calculated without more data. And if the problem were solvable, what would be the use of doing it? We are fond of working upon problems which lead to results of practical value, and though we sometimes work out problems for correspondents, which are simply puzzles, we always feel that the time is misspent, since we are beyond the age when we do such work simply for mental gymnastics.

(10593) W. H. asks: I would be obliged to you for a little information on following: Suppose we take a motor, and from the same motor get the power to run a dynamo, and place both pieces of machinery in a receptacle from which we could extract the air, and therefore form a vacuum. Do you think that we could get more return for the power expended, on account of relieving both machines of the atmospheric pressure, and by depriving the bearings of the oxygen, would they be less liable to heat? A. We know no reason to suppose that a dynamo will perform any better or worse electrically in a vacuum than in the open air. This idea has been advanced very many times. We usually reply that any one can easily try the experiment and find out if it be so. Nor has oxygen anything to do with the heating of bearings. Friction is the cause of hot bearings, and this is as operative in a vacuum as in the air. The friction of the air retards the motion of a machine somewhat. This retardation would be absent in a vacuum. The work of pumping the air out of the receptacle and maintaining the vacuum must be paid for. We feel sure that this would cost more than overcoming the friction of the air.

(10594) E. C. R. asks: If a sealed glass globe containing atmospheric air is weighed in air, and then a vacuum is produced in said globe, and the globe reweighed, will it weigh the same, or more, or less than when filled with air? All other conditions assumed to be equal, and also assumed that the experiment is mechanically possible. A. If a glass globe be weighed with air in it, and the air be then pumped out, the globe will weigh less than it did with the air in it. Air has weight just as really as iron or water. The experiment is not only mechanically possible, but nearly every high school student in the country who studies physics performs it. It is the usual method of determining the weight of air.

(10595) C. R. S. asks: 1. I understand that a pure red pigment should reflect only those lengths of waves which would give the sensation of red. Similarly with green and violet pigments. Do we possess such pigments? And further, in the case of intermediate colors, such as orange or violet, have we pigments which would give waves of nearly one length, or with the orange pigment a reflection of waves confined between the red and green, etc.? A. We probably have no perfectly pure colors in pigments, but the aniline dyes, vermilion, emerald, and Hoffmann's violet BB come very near it. Any pigment may be a combination of two or more pigments, and give a color corresponding very closely to a color in light which has but one wave length. A compound color may appear just like a simple color until it is analyzed. 2. Explain how red and blue pigments mixed give violet instead of black, as would seem to be the result. A. Red and blue give purple, as they should, and not black.

NEW BOOKS, ETC.

A Manual of Hydraulics. By R. Busquet. Translated by A. H. Peake. New York: Longmans, Green & Co. 12mo.; cloth; 312 pages, illustrated. Price, $2.10.

The price of coal has risen so steadily that the ratio of the efficiency of steam engines to their running cost has remained almost a constant, in spite of their wonderful improvement in construction and design. This has caused attention to center upon hydraulic power as a convenient energy source, especially since the developments in electrical science have enabled energy to be conveniently transmitted from the spot where it is produced to the region where it is needed. This book expounds the principles underlying the use of water-power, and discusses the application of these principles to almost every type of hydraulic prime mover in commercial use, showing the relative merits of each type and the circumstances favorable to it. The methods are simple arithmetical ones, and only a very elementary knowledge of arithmetic and geometry is necessary in order that the whole of the many examples may be followed. The measurements have all been changed to "British units," and the constants occurring in the various formulæ modified to suit the reduction. The book occupies the middle ground between the popular descriptive work and the abstruse treatise.

Theory and Practice of Pianoforte Building. By William B. White. New York: Edward Lyman Bell. 8vo.; cloth; 160 pages; illustrated. Price, $2.

The development of the American pianoforte is a study which is interesting to the artisan as well as to the pianist, since the skill of each re-acts upon the work of the other. There has not been wanting a number of writers who have treated of the history of the subject, but an exposition of the correct principles of design has not hitherto appeared in the English language, at least in a form that possesses permanent value to the American manufacturer. "The Theory and Practice of Pianoforte Building," the result of more than two years of conscientious study and research, is a work of technical knowledge in a concrete form. The general outline of the book can be explained with little detail. After a short historical sketch, follows a general statement of the laws that govern the propagation and transmission of sound. This leads to a concise explanation of the peculiarities of stretched strings and their behavior under varying conditions. From this it is but a step to the subject of pianoforte strings, their dimensions, and the manner in which they become the agents of a sound-production in the instrument. The next department is that of resonance and the resonating apparatus of the instrument. The framing that holds together the elements is next subjected to analysis and explanation, with the mechanisms of touch and percussion. The volume closes with the draughting of scales, and the calculations for shrinkage that are rendered necessary by the vagaries of cast iron.

The Steel Square Pocket Book. By Dwight L. Stoddard. New York: The Industrial Publishing Company. 32mo.; cloth; 159 pages. Price, 50 cents.

Many books have been written upon the steel square, but one of pocket size will be met with joy by all who use the tool. Although in this little volume it has not been attempted to describe all the various operations that can be performed with the steel square, the endeavor is made to place those that it does deal with before the eye by illustrations rather than to confuse the mind by complex printed descriptions.

The Architects' Directory and Specification Index for 1907. New York: William T. Comstock. Quarto; cloth; 192 pages. Price, $3.

This directory, known among architects, manufacturers, and dealers in building materials as the Red Book, has just come out for the year 1907, and is gotten up in a very commendable manner. The general list of architects shows an increase, and the change of addresses and of firms has been very considerable during the last year. The activity in building has evidently resulted in many rearrangements among the members of the profession. The list of architectural societies has

been carefully revised, giving the officers for the present year. The building departments are also carefully listed, giving the officers for 1907. The Specification Index for this year has evidently received special attention, and is much more complete than ever before, and will be found a very valuable reference for architects in writing specifications, as well as for the use of builders and contractors in getting estimates on materials. The whole work comes out in attractive shape, and should be appreciated by architects, builders, and manufacturers as a reference book of the names and addresses of architects, landscape and naval architects, professional societies, architectural schools, periodicals, building departments, and all the varied interests connected with architecture.

PETROGRAPHISCHES VADEMEKUM. Ein Hilfsbuch für Geologen. Von Dr. Ernst Weinschenk. St. Louis: B. Heider. 16mo.; cloth; 208 pages; illustrated. Price, 85 cents.

A handbook intended to fill the need for a reference medium that will enable its users to determine the various more frequently met with minerals at a glance. The first of the two parts into which the book is divided is general in its descriptive character, the second part specialized. The cuts of minerals and rocks are admirable, giving a better idea of the forms they illustrate than could be obtained from pages of descriptive matter alone.

THE TREATMENT OF STORAGE BATTERIES. By R. W. Vicarey. London: The Electric Accumulator. With illustrations; 58 pages, paper. Price, $1.

Of the many books that have been written on the electric accumulator or storage battery, as it is commonly called, but few consist of anything more than historical sketches and descriptions of the various types in existence. The need of a book of simple directions is the more marked, since accumulators are in the majority of cases cared for by persons ranging from the electrical engineer, in large plants, to the stable-man, or even to the cook, in country houses. By following the instructions given in this pamphlet many of the difficulties with which storage-battery users have struggled in the past will be done away with.

TEXTILE FABRICS AND THEIR PREPARATION FOR DYEING. With numerous engravings and diagrams. By Prof. J. J. Hummel. New and revised edition. Edited by Paul N. Hasluck. Philadelphia: David McKay. 16mo.; cloth; 160 pages. Price, $1.

A comprehensive treatment in a convenient form for every-day use. The contents of the manual are based on the book written by the late Dr. J. J. Hummel, F.C.S., professor and editor of the Dyeing Department of the Yorkshire College, Leeds. Although many changes in the preparation of textile fabrics have been made since the earlier edition of this book was published, it has been brought up to date and enlarged without omitting any essential parts of the original work.

STANDARD MECHANICAL EXAMINATIONS ON LOCOMOTIVE FIRING AND RUNNING. By W. G. Wallace. Chicago: Frederick J. Drake & Co. 12mo.; leather; 345 pages; illustrated. Price, $1.50.

The first portion of this work is given up to the answers to questions adopted by the Traveling Engineers' Association as a standard for the mechanical examination of locomotive firemen for promotion; each road being supposed to use questions applicable to its own service. The remaining portion of the work consists of articles on the evolution of the Locomotive, Setting Locomotive Valves, Making a Timetable, Fuel Oil and Oil-burning Locomotives, Air-Brake Practice, and of tables of Link Motion, Steam Temperature and Volume, and Train Resistance.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

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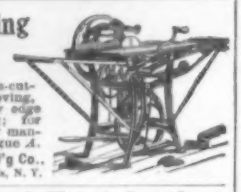

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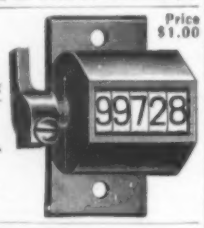

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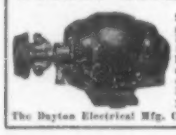

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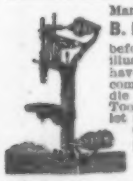

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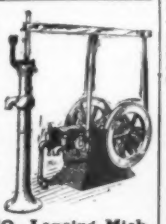

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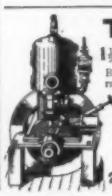

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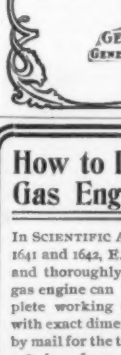

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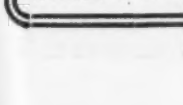

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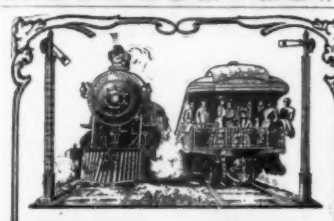

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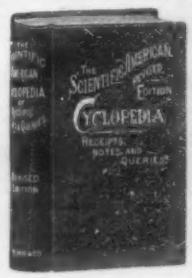

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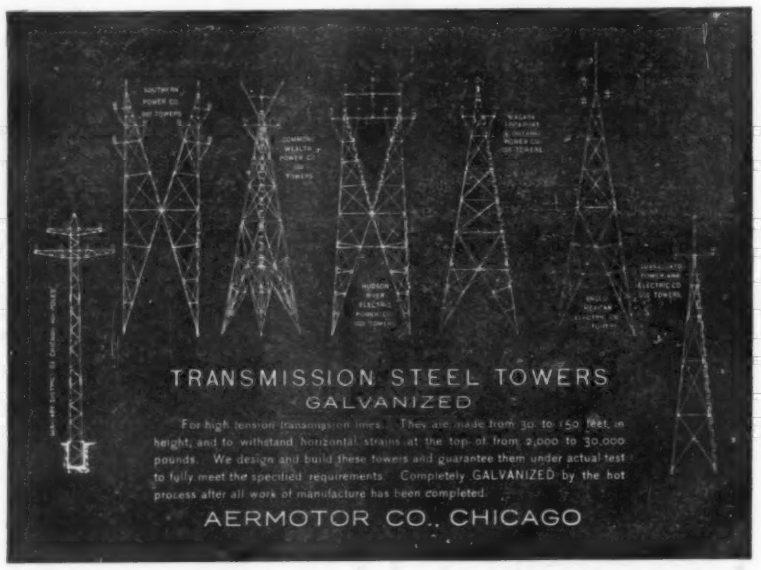
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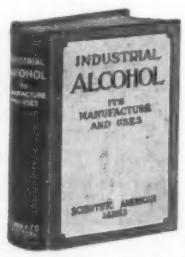

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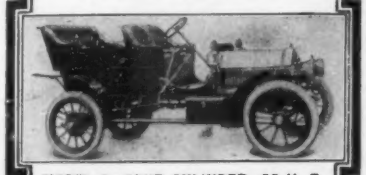

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Soap, toilet, Remmers Soap Co.	63,627
Spoons, souvenir silver, J. R. Watts & Co.	63,689
Squares, Simmons Hardware Co.	63,715
Starch, laundry, New York Glucose Co., 63,646,	63,647
Stationery, certain articles of, Globe-Wernicke Co. 63,724 to	63,726
Stoves and ranges, St. Louis Union Trust Co.	63,619
Tanning extract, Stamford Manufacturing Co.	63,666
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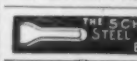

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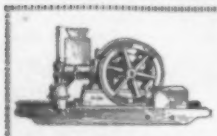

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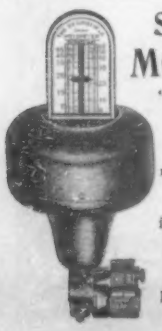

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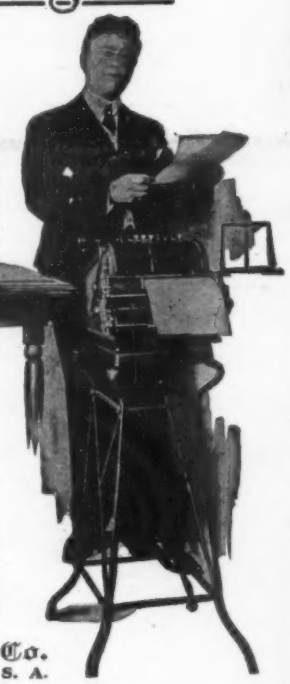

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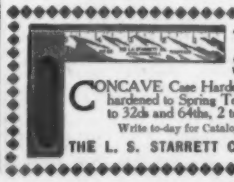

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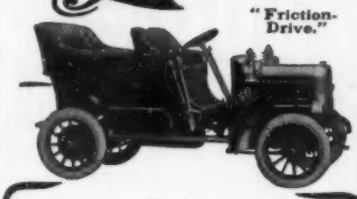

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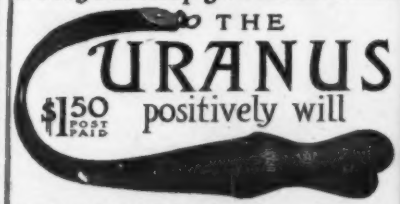

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